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JAPAN AND THE OPEN DOOR IN MANCHOUKUO

THE OPEN DOOR AS INTERVENTION

THE OPEN DOOR AN ECONOMIC ILLUSION

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ENGINEERING FINANCE COMMERCE

VOL. XXIX SHANGHAI, OCTOBER, 1933 No. 10

Japan and Open Door in Manchoukuo[*]

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THE discussion of the Japanese attitude toward the question of the open door in Manchoukuo necessitates a thorough understanding of the developments which have taken place in Manchuria during the past year. I shall, therefore, first of all describe the living realities of Manchoukuo and her achievements during the first year of her nationhood, and then go into the discussion of the open door.

Basic Realities of Manchoukuo

After eighteen months of Sino-Japanese controversies in Manchuria, the supreme question in the Far East to-day (for that matter, in the world at large) is Manchoukuo, the new state of Manchuria, " the child of conflict."

But what are the realities, the basic factors, which led to the organization of Manchoukuo and to the declaration of her independence from China ? Is it true that Manchoukuo was imposed by Japan upon 34,000,000 unwilling Manchurians ?

The first of the basic facts which must be remembered in understanding the realities of Manchoukuo is that Manchoukuo was organized by Manchurian leaders as a protest against the corruption and the maladministration of the former Chang régime ; hence, as a result of an internal revolution. The deceptive grandeur of Marshal Chang Hsueh-liang's empire was entirely due to the imposing war machinery which he had built up at the expense of the people. To quote from Mr. K. K. Kawakami's *Manchoukuo : Child of Conflict :*

> For more than ten years the two Changs, father and son, had exploited Manchuria for their selfish ambitions and profit. Their military expenditure had amounted to one hundred million Chinese dollars per annum, representing 85 to 93 per cent of the total expenditure. It put a staggering burden upon the people. Not only had the taxes been high, but the unlimited issuance of inconvertible paper currency had driven farmers and traders to the wall. Not less than 700,000,000 of these bills, printed in Mukden and New York, had been foisted upon the people. The Changs, through the government banks which were, in reality, their private institutions, compelled the farmers to sell their crops for these worthless notes and then resold them at Newchwang or Dairen for silver or gold. It was a most profitable " racket " unequaled even in the gangdoms of Chicago or New York. Is it any wonder that the Changs earned the enmity of the people and alienated the loyalty of many of their adherents ?

The opponents of the Chang régime merely took advantage of the situation when that deceptive Chang machinery crumbled to pieces from the impact of Japan's drastic actions. Manchoukuo thus s a logical fruit of an internal revolution, and is a Chinese state.

The second basic fact of the Manchoukuo reality is the utter iction of sovereign China. China to-day is merely a geographical erm, without embodying a united nationhood, but divided by warlords and challenged by communists. Outer Mongolia is a Soviet Republic ; both Tibet and Chinese Turkistan are completely ut off from contact with China proper ; Canton is also independent ; n fact, the Nanking Government controls only a few of the original ighteen provinces. So was Manchuria an autonomous state, as President Lowell of Harvard University has so clearly pointed out in *Foreign Affairs.* There is nothing new, therefore, in Manchurian independence, according to such a peculiar division of Chinese sovereignty. Indeed, Manchuria under the Changs was, for all practical purposes, independent of all external control. Marshal Chang Hsueh-liang maintained his own army of 350,000 men, operated his own great arsenal, kept the Chinese Government revenues for himself, issued his own money, and even carried on diplomatic negotiations of his own. It was independent warlordism *par excellence.* Here, the key idea is China's regionalism.

In the third place, Manchuria, historically speaking, is the land whence sprang the Manchus who conquered and ruled over China for two and a half centuries and who kept Manchuria as their private hunting ground, even forbidding Chinese immigration thereto. It was most rational, therefore, that His Excellency Henry Pu-Yi, the last reigning Manchu Emperor, who was deposed in 1911 and whose contract with the Chinese Republic was ruthlessly violated by the latter, should return to the land of his forefathers and head the government which bears the traditional name of his dynastic estate. In this sense, the Manchus ruled over China for over 260 years, while China never governed Manchuria, and the " Revolution of 1932 " which resulted in the organization of Manchoukuo should more properly be called the " Restoration of 1932."

This brings us to the last factor, namely, the Japanese influence. For many years Japan had been suffering in Manchuria the effect of Sino-Manchuria " revolutionary diplomacy," manifested in insidious propaganda, countless violations of her treaty rights, and innumerable insulting outrages. At last having been forced to take a determined step to safeguard her vital interests in Manchuria against Marshal Chang's irresponsible actions and " passing-the-buck " diplomacy, it is only natural that Japan should have sympathized with the just aspirations of the anti-Chang leaders to establish a new government whose slogan is " Equal Opportunity for All," and whose friendly policy of co-operation will replace the " revolutionary diplomacy " of the former régime. In short, what government Manchuria should have is properly a Chinese affair ; but what the attitude of that government should be toward Japan's vested interests in Manchuria is a matter of utmost national concern to Japan. It is not the land which she covets ; it is her rights and interests which she insists must be protected. This is why Japan has been and still is giving her unqualified support to her new neighbor, even at the expense of being grossly misunderstood by the world at large.

In short, Manchoukuo, with or without the official recognition of the world powers, is to-day an international reality, as real as the states which emerged in Europe after the World War.

Manchoukuo's Achievement

Such being the living realities of Manchoukuo, Japan recognized her as the only road to peace and order in the Far East. Now that Japan, because of that conviction, has expressed her desire even to withdraw from the League of Nations, whether or not Japan's present policy is wise and justified depends solely upon whether or not Manchoukuo can live up to the trust which Japan has placed upon her.

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[*] *The Annals of The American Academy of Political and Social Science,*

Fortunately, in celebrating her first birthday (March 1, 1932, in Manchoukuo will ever correspond to July 4, 1776, in the United States of America) Manchoukuo has already given a good account of herself. She has fearlessly launched various administrative reforms; she has successfully balanced her national budget; she has reformed her taxation and revenue system to lift undue burdens from the shoulders of the masses and to doom the profiteering "tax racket"; she has introduced a uniform monetary system in place of a score of worthless notes, and the new Manchoukuo note commands the par price with a premium in the Shanghai market; she has established a central national bank with its branches all over Manchoukuo to bring about financial stability and responsibility; she has practically restored law and order as it exists nowhere in China proper; and she is now projecting numerous grandiose plans, including extensive railway constructions and industrial expansion. No wonder that the Chinese financiers in China proper are already taking steps to invest in Manchoukuo enterprises!

Most noteworthy and striking is the growth of trade. During her first year, 1932, in spite of unsettled conditions in Manchuria and the world-wide depression, the Manchoukuo trade increased tremendously. Imports passing through the port of Dairen increased by 111 per cent; exports by 58 per cent. In this increase, Japan, Great Britain, and China benefited most. It is true that the trade of the United States decreased about 28 per cent, but this figure involves the depreciated currencies in Japan, Great Britain, and China, and the high value of the American dollar. Moreover, the American exports to all countries decreased by about 33 per cent during the same year, so that Manchoukuo shows a better figure for the American trade than do the other countries.

Contrast this new Manchuria with the conditions in China proper, where perennial civil wars continue to hamper the establishment of a united and responsible government, where rival warlords fatten themselves at the expense of helpless masses, where "revolutionary diplomacy" and anti-foreignism play havoc upon foreign rights and activities, where responsibility is tossed around like a baseball and unsettled diplomatic cases multiply in numbers, where "illegal" boycott as an instrument of national policy baffles international trade, and where communism adds its challenging color to the already fictitious law and order. Is it surprising, then, that millions of Chinese coolies have sought and are still seeking in Manchuria their land of peace and plenty, of "milk and honey"? Is it a wonder that the powers, including the United States, still insist upon patrolling the Chinese waters with their own gunboats?

The example of Jehol—

Because of such a contrast between Manchoukuo and China proper, one can now see the gap which separates the obvious Chinese propaganda from the realities of Manchoukuo. Take the case of the recent occupation of Jehol. On the one hand, we were told that China would resist the Japanese and Manchoukuoan "invasion" of Jehol "to the last man." What actually happened was surprisingly different from such an ideal. In fact, Mr. Hallet Abend, the *New York Times* correspondent in China, told us that Governor Tang Yu-ling oppressed and squeezed the people of Jehol to the last minute, and that "all homes were barred and guarded and women and children were not seen on the streets . . . . as they feared looting and violence by Chinese troops"; but that "the moment the Japanese forces entered, Japanese and Manchoukuoan flags were flown and excited and cheering crowds of men, women and children thronged the streets," and that they even sent presents to the tired soldiers. And here is his fascinating concluding paragraph:

> Typically climaxing the grotesquely farcical nature of Chinese "resistance to the last man" was the scene when 120 Japanese entered Jehol City, a city of 30,000 people still occupied by 5,000 fully armed Chinese troops who surrendered and submitted to being disarmed without a single shot fired on either side.

The people of Jehol find peace and security under the Manchoukuo régime, but found oppression and misery under the former dictatorship of warlordism.

Capacity for development—

In the light of such a superb record of achievement for the first year of her nationhood, Manchoukuo may be said to have already amply demonstrated her capacity for future growth and development. The land is fertile; the natural resources are plentiful; and the 34,000,000 people are sturdy and hard-working. Without attempting an impossible autopsy on the future, therefore, it is safe to believe that the period of readjustment through which Manchoukuo is now passing will not be long; it will soon be followed by a period of reconstruction, growth, and development. If Manchoukuo replaces the tyranny of warlordism with an honest and efficient government, converts the "revolutionary diplomacy" based upon anti-foreignism into a friendly policy of international co-operation, and sweeps aside the menace of disorder and banditry in favor of law and order, then Manchoukuo and China and Japan and the world, including the United States, will be tremendously benefited by the birth and the healthy growth of the new state of Manchoukuo. In this reconstruction period, both Japan and the United States, I believe, have important rôles to play.

Manchoukuo's Foreign Policy

Such is the new outlook in Manchuria; but we are once more facing the old and recurring question of the open door. Our neighbor in the Far East has been using the English language most effectively to impress Americans that Japan is going to close the door in the Far East. In the past, however, the realities have been otherwise. Not only did Japan keep her own doors wide open, but she was influential, perhaps more than any other power, in keeping the doors of China also wide open for international trade. To-day, similar propaganda is widespread in America to the effect that Japan's special relationship with Manchoukuo will make it impossible for Americans to hope for the open door in Manchuria. Nothing is farther from the realities of Manchoukuo and the aspirations of the Island Empire. Let us first consider the position of Manchoukuo with regard to the open door.

At a convention held in Mukden during February 16-18, 1932, the assembled delegates declared, among other things, that "The state will develop commerce and industry and be ready to welcome foreign investment, regardless of nationality, in pursuance of the principle of the Open Door and Equal Opportunity" and that "All obligations for foreign loan secured by treaty agreement previously concluded by the Republic of China, if such obligations belong to the territory of the new state, shall be recognized in conformity with international usage."

The Declaration of Independence which the Manchoukuo Government issued on March 1, 1932, contained the following significant paragraph:

> The foreign policies of the new state shall be to seek and further promote cordial relations with foreign powers, winning their faith and respect, and to strictly observe international conventions. The debt obligations accruing within the territory of Manchuria by treaty stipulations with various countries prior to the establishment of the new state shall be acknowledged according to the usual international conventions. Foreign investments by all nationalities uniformly shall be welcomed for the furtherance of trade and exploitation of natural resources, thus bringing the principle of the open door and equal opportunity and the like a fuller realization.

When, on March 12, 1932, Hsieh Chieh-shih, the Minister for Foreign Affairs, appealed to the powers for recognition of Manchoukuo, he pronounced the following as one of the seven cardinal principles of Manchoukuoan foreign policy: "That with regard to the economic activities of the peoples of foreign nations within the State of Manchuria, the principle of the open door shall be observed."

These are not empty proclamations. In the short period of one year of her existence, Manchoukuo has already taken necessary steps to insure the proclaimed principles. She has most fastidiously observed the foreign obligations, for which she is not responsible but which were bequeathed by the old régime, of warlords' debts to foreign commercial firms. She is paying to China not only her own quota of salt-monopoly revenue, but also the arrears left by the warlords. All custom houses in Manchuria are now under the direct control of the Manchoukuo Government, but no change has been made in customs tariff.* Under the old régime, railway discrimination against foreign goods or foreign shippers prevailed in violation of a provision of the Nine-Power Treaty; under the new régime such a discriminatory railway policy has been reversed, and to-day all shippers, native and foreign, are required to pay uniform rates. Nowhere and in no respect has the principle of the open door been encroached upon. Thus, trade in Manchoukuo has become a matter of legitimate competition, unhampered by governmental interference or the iniquities of warlordism.

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*Since the above was written the tariff of Manchoukuo has been revised—downward.

Manchoukuo's Foreign Trade

I have already referred to the phenomenal growth of Manchoukuoan trade during the past year. Further perusal of those trade figures by countries bears out the above summary that Manchoukuo's door of foreign trade has been kept wide open and that there are other nations whose increase, both in exports and imports, was greater than that of Japan. The Manchoukuoan exports to Egypt during 1932 increased by 1,061 per cent over those of 1931; to Russian Asia by 556 per cent; to France by 278 per cent; to Great Britain by 227 per cent; and to Belgium by 150 per cent; while the increase was only 47 per cent for Japan. In the field of imports into Manchoukuo, Belgium led the way with 469 per cent increase; Egypt came next with 194 per cent, followed by France with 166 per cent and Japan with 154 per cent. If these figures do not reveal fair competition, what will?

And here is a sidelight which is most significant to the United States, but which is often overlooked. In the first place, many American goods are first landed in Japan and reshipped into Manchoukuo, entering the latter country technically as "Japanese goods." It is estimated that Japanese traders carry no less than 40 per cent of the American trade with China, including Manchoukuo.

In the second place, a large amount of American raw materials is imported to Japan and the Japanese manufacturers export to Manchoukuo the finished products, thus augmenting the American trade considerably. When one notes, for example, that the imports into Manchoukuo in 1932 of cotton yarn and fabrics increased by 146 per cent, of petroleum by 272 per cent, and of iron and steel by 132 per cent, one must realize that a very large share of the goods under those headlines were either American goods or depended upon American raw materials. Japan grows no cotton, but purchases more than 10 per cent of the American crop; and when the Japanese manufacturers sell cotton yarn and cotton piece goods to Manchoukuoans, which constitute the largest group in the Japanese exports to that country, Japan is selling American cotton spun in Japanese mills. The same is substantially true also with regard to petroleum and iron and steel.

Thus, on her first anniversary on March 1, Manchoukuo announced her studied program for an extensive economic construction to be carried out under four fundamental principles, the third of which reads as follows:

> The policy of the Open Door and Equal Opportunity shall be applied in the development of natural resources and the promotion of industry. The opportunity for investment in the country shall be open to the world; the technical skill and experience of the advanced nations of the world shall be introduced and fittingly applied.

Japan's Foreign Policy

Now, what about Japan? It is a matter of indisputable historical fact that Japan has accepted unconditionally and both upheld and faithfully observed the principle of the open door since it was enunciated by Secretary John Hay in 1899—and that, in spite of repeated criticisms which were directed against her from time to time. Let me cite a few illustrations.

During the period of Japanese military occupation of Manchuria through and immediately following the Russo-Japanese War of 1904-1905, many complaints were registered by the American members of the business community in Shanghai that Japan was violating the open door in Manchuria. These accusations finally led to an investigation of the prevailing situation in Manchuria by three American merchants representing the Shanghai American commericial interests, for the purpose of reporting to the American Minister at Peking and through him to the Department of State. The investigation was made during June 1906. At Newchwang, through which port practically all foreign trade of South Manchuria passed at that time, the investigators reported that orderly conditions prevailed under the Japanese jurisdiction and that they had no proof of the alleged violation by Japanese in levying a heavy likin on goods going to the interior from Newchwang. They continued:

> After a most comprehensive inquiry, it is most difficult, if not impossible, to offer any satisfactory evidence to substantiate the theory that the Japanese Government, through the instrumentality of either its military or civil authorities, is at present purposely interfering with or placing any obstacles on the path of other nations for the industrial exploitation of this important part of the Chinese Empire.

In 1914, Americans and Japanese again clashed over the question of freight rates on the Manchurian railway. In March of that year, the Japanese railway authorities, in conference with the Korean Railway and the South Manchuria Railway, adopted a measure by which all goods, Japanese and foreign, entering Manchuria through the Antung-Mukden line of the South Manchuria Railway were to be carried at rates 30 per cent less than the regular rates. This was done to make the railways in Korea and Manchuria the main artery of trade and communication between Japan and Manchuria. The new policy provoked renewed American complaints, not because the new rates were not applicable to their goods, but because American goods, entering Manchuria largely through the port of Dairen and not from the Korean side, did not get their benefit. The Americans now demanded that the South Manchuria Railway should adopt the same low rates for goods imported into Manchuria through the port of Dairen or Newchwang via foreign ships. In March, 1915, the American merchants won the point, and since then there has been no occasion for complaint on the part of foreign trading interests.

Japanese Enterprise Increases Foreign Trade

If we now turn to a more positive phase of the open door in Manchuria, we discover that, contrary to foreign assumption, Japanese enterprise has always brought in its train a signal increase in foreign trade. Such was true in Korea and in Shantung; but it was more so in Manchuria.

Korea—

In 1903, the American exports to Korea amounted to only $199,188; the next year, when the Japanese gained the commanding position in the peninsula, the figures suddenly swelled to $906,557; by 1913, three years after the Japanese annexation of Korea, they reached the handsome figure of $3,920,000, and by 1929, $5,000,000.

Shantung—

In Shantung, in the brief period of Japanese occupation between 1916 and 1922, the same thing occurred. During the five years from 1916 to 1920, the Japanese management of the Shantung Railway, completely reversing the German policy, bought $10,397,000 worth of materials and machinery from abroad. Of this sum, about one-third, or $3,047,000, went to American manufacturers. In 1921 the same management purchased from abroad, mostly from America, 18 locomotives, 293 thirty ton coal cars, 11 passenger cars, and 12 cabooses. Since Japan left Shantung in 1923, the Shantung Railway has degenerated rapidly and the purchase of foreign materials has been transacted only in dreams.

South Manchuria Railway—

In Manchuria we saw the same phenomenon carved out in bolder relief. Under the Russian régime the railways were built and equipped with Russian materials, and foreign goods had a very slight chance; about the only American imports were cotton piece goods, and that to a negligible amount. The advent of the Japanese and the organization of the South Manchuria Railway changed that condition at once. Between 1907 and 1919, for example, the South Manchuria Railway alone bought American materials to the value of $93,790,000, and the other Japanese firms in Manchuria imported American machinery and materials to the amount of $60,000,000, making the total for twelve years $153,790,000. In 1920 alone, the South Manchuria Railway paid out $20,000,000 for American materials. In the twenty-two-year period ending March 31, 1929, the South Manchuria Railway alone had purchased from abroad $251,000,000 worth of materials, of which the United States supplied 26 per cent, exceeded only by Japan's 38 per cent. Of the entire rolling stock now owned by the Company, 482 locomotives, 6,574 freight-cars, and 440 Pullman sleepers are of American origin, while practically all the steam shovels, cranes and dredges are also of American origin, and no less than 90,000 tons of American steel rails have been used for its tracks. Certainly, this is not the closing of the open door.

Manchuria's Foreign Trade

If we now turn to the foreign trade of Manchuria, we see further proof of the open door. Japan's contribution in transforming Manchuria, to borrow a British publicist's phrase, into "a flourishing oasis in the howling desert of misrule and banditry" is now history and does not necessitate my detailed repetition here. Since 1905, when she succeeded to the Russian leases to the Territory of Kwantung and the railways, Japan has invested almost two billion yen in her effort to develop railroads, coal mines, iron works and various commercial and industrial activities, as well as to spread the light of civilization, especially in the fields of education, medicine, and sanitation. Because of that epochal transformation, the foreign trade of Manchuria has grown with leaps and bounds, and the powers, including the United States, have shared its benefit abundantly.

Before the advent of the Japanese, Manchuria's foreign trade was negligible ; it rose from 25,000,000 haikwan taels in 1907 to 755,000,000 kaikwan taels in 1929, while it fell off to 703,000,000 haikwan taels in 1930, largely on account of the world-wide depression. Divided into countries, Japan's trade (including that of Korea) with Manchuria during the twenty-three years from 1908 to 1930 increased seven times ; Great Britain's (including that of Hongkong, India and other British colonies) increased more than thirteen times ; and America's (including that of the Philippines) increased more than four times. While Japan bought from Manchuria more than she sold to it, exactly the reverse was true of the American and British trade. Compare, for example, the Japanese and American figures. The Japanese imports from Manchuria in 1908 exceeded exports to Manchuria by 2,501,000 haikwan taels, while the same unfavorable balance rose in 1930 to 38,923,000 haikwan taels. In contrast, the American exports to Manchuria in 1908 exceeded imports from Manchuria by 6,365,000 haikwan taels, while the same favorable balance increased in 1930 to 12,073,000 haikwan taels. Surely, again there seems to be no reason to allege Japanese violation of the open door in Manchuria because of her preponderant influence there.

Japan's Geographical Advantage

If it is argued, however, that Japan far outranks other nations in the amount of her Manchurian trade, and that therefore she is not observing the open door, it should be remembered that the greatest factor in this case is the advantage which Japan enjoys in Manchuria by reason of her geographical propinquity, and not the open or closed door there. Most assuredly the open door does not, and should not, mean that all trading nations in Manchuria shall have an equal amount of trade. It is inevitable and logical, for obvious economic reasons, that Japan, who is more favorably situated than other powers, should have a relatively larger trade. Moreover, Japan's investments in Manchuria are estimated at Y.1,900,000,000, or 77 per cent of the total foreign investments there : while British and American investments amount to Y.39,600,000 and Y.26,000,000 respectively. The same principle seems to apply anywhere else, say in Cuba or Panama ; but I have yet to hear any Japanese making ado about the "closed door" of Cuba or Panama, although the Japanese trade with those countries is extremely small, and the Monroe Doctrine does not stand for the closed door.

Such, then, is the part which Japan has been playing in upholding and encouraging the open door in Manchuria in the past. Is it not reasonable to believe that she will continue the same policy in the future, and will co-operate with Manchoukuo for the same purpose ? Japan has recognized Manchoukuo because Manchoukuo has avowed to respect the principle of the open door and equal opportunity to all nations, as well as the treaties which existed between China and foreign powers, while her statesmen have repeatedly affirmed her intention to uphold and observe the open door in Manchuria. In short, Japan and Manchoukou are united to make Manchuria safe for international trade and activities.

Trade Opportunities in Manchoukuo

In the light of such a historical background and such pronounced policies, finally, study the well-weighed program of future economic development in Manchoukuo as it was announced upon her first anniversary this year. That gigantic program includes, among other things, the construction of 25,000 kilometers of new railroads of which 4,000 kilometers will be finished within the next ten years, the building of 60,000 kilometers of new roads within the same period, the improvement of three harbors, the promotion of navigation over the four rivers, and the development of 3,500 kilometers of new airways within the next three years. It is not difficult to see, therefore, that all nations, including Japan and the United States, have significant rôles to play in that development. Especially is this true of the United States. For Japan alone, even if she is allowed to do so, cannot supply all the needs of Manchoukuo's greater future. Indeed, it remains for the United States to provide Manchoukuo with materials which she alone can supply, such as steel rails, construction machinery, tractors, agricultural machinery, electrical goods, motor-cars, and the like. In short, the history of the past twenty-five years in Manchuria to which I have referred above is about to repeat itself on the newly organized stage of Manchoukuo, possibly on a more gigantic scale.

It was Lord Charles Beresford who said, in 1899, that the open door would be of no use "unless the room inside is in order." Let it be added that no order can be maintained within the room unless an honest and responsible person takes charge of it. In other words, the open door, as a practical matter, can be enforced and become profitable only where law and order are maintained by honest and responsible government. In chaotic China the doors may be wide open, but the powers, on account of continued disorder inside the room, are forced to spend more for maintaining their gunboats on the Chinese waters than they derive from their trade relations—something like two dollars for every dollar gained, or possibly more. In Manchuria, Manchoukuo has already announced her adherence to the open door policy, and the history of the past year has convincingly demonstrated that the door is wide open. Moreover, an honest and responsible government has taken charge of the "room." What Manchoukuo now needs is to complete the good work of putting and maintaining the "room inside in order," so that the open door will be useful both to herself and to other powers. That is precisely what Manchoukuo is now doing, and what Japan is co-operating with her to do.

Open Door is Economic Illusion

By HENRY KITTREDGE NORTON

Following is the text of a recent address delivered before The Academy of Political Science in New York.

ONE of our most widely accepted ideas is the necessity for the open door in China. Our policy in China for the last hundred years, like that of every other Occidental power and, more recently, of Japan, has been shaped by the belief that China is some day to become a vast market for manufactured goods. We have desired to preserve an equal opportunity for our producers to sell in that market ; we have insisted that the door to China should be kept open for that purpose. This theme runs all through our political dealing with China, and with the other powers in China. When we have protested against their advances, we have sometimes been able to restrain them ; at other times we have insisted that they take us along with them, so that whatever the outcome might be, we should still preserve our parity of opportunity with them.

The history of the nineteenth century in England is vastly influenced by the fact that England was increasing its exports to a non-industrial world. That was possible not only because that country had great producing power, but because she had an almost unlimited capacity to import goods which were not and could not be produced at home. Production was, therefore, the dominant factor during all that period. There was no question as to the value of imports that would enter, or the extreme variety of the articles which might be imported. It was simply a question of how much England could produce for export, and her foreign trade would take care of itself.

Any interference, then, on the part of any other nation or body with the export trade of England became practically a *casus belli*. The prospect of great markets abroad was the cement which held the British Empire together. It was also the inspiration for the doctrine of free trade. Naturally, a country which depended on its exports and imports to the extent which Great Britain did, would be in favor of free trade—the greater the flow of trade in both directions, the greater her prosperity.

In a world in process of industrialization the possibilities of expansion appear to be unlimited, and the lack of diversity in England's production made huge exports a necessity. When the United States came into the industrial picture, it was natural that we should take our doctrine as well as our technique of industrialism from England. England was ready to fight for access to markets, therefore we should be ready to do likewise. We were, however, averse to taking and possessing and administering non-contiguous territory. We have overcome that aversion in certain instances, such as Alaska and Hawaii and the Philippines, but nevertheless the aversion remains, and certainly at no time has there been any general sentiment in this country which would have been favorable to taking over any part of China.

Possibilities of Chinese Markets

But all through the nineteenth century we did insist upon access, upon equal terms, to the enormous potential markets of China. The possibilities of those markets have been the theme of writers and publicists and economists through all the decades in which Europe and America have carried on trade with China. Four hundred million people with a very low production capacity —very low at the present time—inspire an enormous amount of statistics and speculation upon possibilities. The one great statistic on China which has survived much discussion is that of Wu Ting Fang, who suggested that if the shirt tail of every Chinese could be lengthened one inch it would keep the mills of Lancashire going for the rest of time. Now there is at least one difficulty with Dr. Wu's analysis, and that is that most Chinese have no shirt tails. In other words, the buying power of China has never come up to the enormous aspirations and hopes of those who have described the vastness of this potential market. But even if Dr. Wu had been talking of realities, there is another difficulty to which I invite your attention.

The recent disturbed years have raised some new inquiries in the world of economics. Slowly and grudgingly we have been learning that consumption can be more important than production—that the business and profits of industry cannot rise above the level established by the amount of purchasing power which industry itself distributes to that part of the population which will spend it for consumers' goods.

This realization is gradually transforming our thinking through the whole range of economics. Sale schemes, advertising, installment sales, all fail to serve the desired end while the total body of wages, the major determinant of consumption, is going downward. Perhaps one of the most encouraging things during the new Administration is a report which was made to the United States Chamber of Commerce and was summarized in the *New York Times*. In that report a committee of a large business and employing body officially recognizes the determining part which wages play in the consumption of the products of industry.

Balance Between Exports and Imports

This analysis of our economic structure has now received sufficient acceptance so that it is pertinent to inquire as to its implications in the field of international trade. How much economic justification is there for the assertion that we need foreign markets in which to sell our surplus products? How much of our surplus can we possibly sell abroad to the advantage of our national economy as a whole?

Eliminating gold and services as minor items, so far as our own trade is concerned, we know that exports can be paid for only by the import of goods. May I suggest, indeed, that we reverse the usual view of foreign trade and consider it not as a means of disposing of our surplus production, but as a means of acquiring the things which we cannot profitably produce within our own territory, such as rubber, tea, tin, coffee, cocoa, and silk. And there are no restrictions of any momentous character upon the purchase and import into this country of those goods; we can buy all we are willing to take and pay for. Those goods are paid for in United States dollars, which are expendable in this country, and when they are expended here they result in an equivalent value of exports going out of the country to pay for those imports which came in.

To that trade there are no serious barriers. It automatically takes care of itself; it requires no Department of Commerce to push it; it is a part of the perfectly normal circulation of trade between nations. That kind of trade is profitable to both sides. It is not responsible for conflicts and raises no serious problems.

When we try to sell goods abroad, however, over and above the amount that is necessary to pay for the imports which we want, we find it impossible to receive payment except in goods which compete with those of our own producers. Forcing our export trade under these circumstances may simply profit some of our industries at the expense of others; there may be no profit whatever to the national economy as a whole. If we add the purchasing power due to the sale of the exports, the imports which pay for them use up an equivalent amount of purchasing power, to the detriment of the domestic producers who lose business because of those imports.

If there is a sufficient increase in consumption because of the lower price at which the import is sold, such trade may be advantageous, just as the import of goods which we do not produce at all is advantageous.

But even if that is the case, we are face to face with the fact that our exports cannot exceed our imports. Also, as a counter-thought to that, we may be assured that the value of our exports cannot fall below the value of our imports. In other words, a fairly exact balance between exports and imports is established by the economic requirements of a national economy such as our own.

The significance of this is that in the case of an enormous producing mechanism like the United States, with its tremendous variety of products, its tremendous resources of raw materials, of capital, of men, of labor, of organization, of scientific research, our export is entirely under our own control, because it will be just exactly what we import, and our imports are unquestionably under our own control.

Our Favorable Balance of Trade

Now, it may be said that during the years from 1915 to 1926 or 1927, our exports grew enormously, and far out-distanced our imports. In fact, we had a favorable balance of trade—that word "favorable" is a little humorism on the part of the classical or earlier economists, and indicates that we have sold more goods than we have bought. It was a favorable balance of trade as long as other countries furnished the payment for that extra export in gold. Gold was looked upon as value instead of as a measure of value, and therefore the nation which had a "favorable" balance was importing gold.

The present volume of international trade has run clear away from any possibility of a general settlement of favorable balances by gold. Therefore we have found it necessary, during this period of the expansion of our imports, to adopt a device which made it appear to us that we were making money. We therefore loaned foreign nations, between 1914 and 1928, some twenty-nine billion dollars, and of course that money was shipped to the foreign nations in terms of our exports. The total of that lending has a suspicious similarity to the total of our "favorable" balance of trade during those same years.

Now, it is quite impossible for us to get back any of the principal or the interest on that money without taking it in goods. Up to date, this simply means that our so-called favorable balance of trade has been a national gift to the rest of the world, and is to be kept by the nations as a gift until such time as we are willing to accept payment therefor in terms of the import of goods. So, despite this apparent rapid expansion during the last decade and a half, the statement remains true that our exports—at least our profitable exports—are limited by our imports. If we want to include gifts, then we can export as much as we like, and I suspect there will be barriers erected against such exports.

Does the Open Door Concern Us ?

We can and do fix absolutely, then, the amount of our exports by the amount which we import. Whether that export goes to China or to Timbuktu matters little to our economy. If it is bought in our market, at our prices, it can make little difference to us or our producers where it goes. It will go out somewhere, dollar for dollar, as our imports come in.

That is in contrast to England's ninteenth-century economy, which was built on foreign trade, and in which the problem of consumption never arose. The British could always take as much as they could get, and if their exports outran the imports for a time, they called that an investment of capital. But they always were willing to receive more goods than they exported, so that in the end these investments were paid. We insist upon limiting our imports, but we still want to go on exporting more and more, and calling the excess an " investment of capital." But the situation in England was different from the situation which we have in this country, with its enormous and varied producin capacity. Our export trade runs not against the limit o our production, as it did in England, but against the limit o our consumption—our consumption in the international market which is the amount we are willing to import and pay fo with dollars.

Now that, obviously, is far less subject to political maneuver in other parts of the world, no matter where, than the kind o trade with which England was concerned in the last century. I our external as in our internal economy, we can simply sell according to the purchasing power which we distribute. In foreign trade that is the value of our imports. In other words, whatever happens to the open door in China or to restrictions upon trade in other parts of the world, it need not concern us from an economic point of view so long as our potential exports still remain far above the amount of the imports which we are willing to accept in payment therefor.

Are we then, in demanding an open door, asking for something which cannot possibly benefit us ? If our exports are limited to the value of our imports, why seek an outlet for more exports ? If the consumption of our goods by the rest of the world is limited by the purchasing power which we distribute as payment for imports, and that purchasing power will be used to buy our goods in any case, the open door is an economic illusion. If it has no economic justification, is it not pertinent to ask, What is its desirability as a Governmental policy ?

The Open Door Policy as Intervention*

By TYLER DENNETT, Professor of International Relations at Princeton University

OUR passionate American desire to catalogue and to classify may lead to astonishing results, but it certainly helps to clarify our thinking.

Foreign policy in general may be classified under " intervention" and " non-intervention." We have no difficulty in placing the Monroe Doctrine where it belongs, under intervention. The rejection of the mandate for Armenia belongs under non-intervention. And so we go on down through the list. I use the word " intervention" in its broadest sense, not in the technical sense of the international lawyer. For the purpose of this discussion I mean by intervention any form of interference, pacific or military, in the affairs of another state.

A first thought there seems something incongruous in placing the open door policy under intervention. The flavors of the two do not seem to blend well. The open door policy proclaimed a doctrine of freedom—of equality of privilege. It was a live-and-let-live policy ; it rhymed with the lofty sentiments of the rights of man and the Declaration of Independence. On the other hand, intervention is associated with varying degrees of interference in the affairs of sovereign states. The word is inescapably associated with some form of coercion, with deprivation of complete freedom of state action. A closer examination nevertheless will show beyond a doubt that we cannot place the open door policy under the head of non-intervention.

The open door policy, like babies, began small and grew bigger from year to year, but we need not stop to trace its growth. It was as essentially an intervention policy when it was small as a baby is human as soon as it is born.

American Policy Expands

In the latter part of the last decade of the last century, the American Government abandoned, as concerns the Far East, the traditional doctrine of the Two Spheres. There had been small interventions in earlier years (Perry's Expedition is difficult to classify as anything else), but for the most part these movements had been mere gestures. In July 1898 we acquired Hawaii, thus bringing to a logical conclusion a Hawaiian policy which was formulated at least half a century before. That was the first step. A few months later we demanded and secured the Philippines. That was the second step—a clear case of intervention outside the Western Hemisphere. The third step was the Open Door Notes of September 6, 1899.

The object of these notes was to pledge all the interested powers to acquiesce in equality of certain trade and commercial privileges. as between themselves in China. This equality seemed to be threatened by the recently asserted claims to spheres of influence and interest. Specifically the threat issued chiefly from Russia, although Germany's intentions were not then perfectly clear. Geographically, the Open Door Notes were drafted with Manchuria and North China chiefly in mind. The objective was to place an obstacle in the way of Russia's closing the Manchurian and North China markets.

It has for some years been believed that the Open Door Notes were drafted not by John Hay who signed them, but by W. W. Rockhill, who at that time was Director of the Bureau of American Republics, but who also served informally as Hay's technical adviser on the Far East. This belief as to the authorship of the Notes may be correct, but the authorship of the policy should be credited to still a third party, not an American at all—Alfred E. Hippisley, a British subject, a friend of Rockhill's, who had served for some years in the Foreign Inspectorate of Chinese Maritime Customs under the famous Sir Robert Hart.

British Influence on American Government

Several times in the preceding eighteen months the British Government had sought to interest the United States in intervention in China. The object of British alarm was Russia. The first suggestion was contained in a note from the British Embassy, March 8, 1898, which Pauncefote was requested to deliver personally to the President. The reply was a prompt rejection. The second suggestion came from Ambassador Hay in the following June. Hay wrote a personal letter to President McKinley, which the latter referred to Secretary Day. The Secretary replied to Hay, July 14, 1898, again repulsing the idea. A third proposal was made the following December. Lord Beresford made a fourth.

**The Annals of The American Academy of Political and Social Science.*

Late in July 1899, after having already had a conference with Hay, Hippisley wrote to Rockhill:

> I venture to suggest that the United States lose no time in calling the attention of all the powers to the changes now taking place in China, and, while disclaiming any desire on her part to annex territory—(in ?) express (ing) her determination not to sacrifice (for ?) her annually increasing trade, any of the right and privilege she has secured by treaty with China: and, to assure this end, that she obtain an undertaking from each European power that all the Chinese treaty tariff shall without discrimination apply to all merchandise entering its spheres of influence; and that by any treaty, ports in them shall not be interfered with.

Here, not very felicitously expressed, is the substance of the Open Door Notes.

When some one, probably Mr. Adee, objected that such a course would expose the Administration to the charge that it was merely pulling British chestnuts out of the fire, Mr. Hippisley replied, August 16, that it would be better for the American Government to lead than to follow England. There seemed to him to be only the two choices. He said:

> I don't for a moment believe that the American manufacturers will sit by with folded hands and see these districts closed without making an effort to retain them. Pressure will therefore be brought to bear upon the Administration and it may have no option but to take some such action as I have suggested.

Secretary Hay was convinced and immediately requested Mr. Rockhill to draft a memorandum on the subject. In another three weeks the famous Notes were on their way.

The motive of the Open Door Notes was the desire to devise some peaceful method to check Russian political and commercial advance in North China. British and American trade were jointly involved, but with this difference, that American commercial interests were largely prospective, while British interests were actual.

There is neither the time nor the necessity to follow through the resulting correspondence with the powers, although it may be observed that Hay never secured such an agreement as was claimed. I merely pause to observe that the Hay notes fitted into a pattern of intervention which had been repeatedly urged by the British Government for a decade.

The Integrity of China

Nine months later, faced with the immediately threatening prospect that Russia would take advantage of the Boxer uprising to conquer North China, Secretary Hay put out the circular of July 3, 1900. This document set forth the principle of the integrity of China as a matter of international concern. This new doctrine, so like and at the same time so utterly unlike the doctrine of Article X of the Covenant, was an essential supplement to the open door doctrine. Without the second doctrine, the first could never mean much. The area within which the open door is to be applied must be defined and protected.

Again John Hay announced that his doctrine was accepted by the powers, but the facts were quite otherwise. Actually no power, with the possible exception of England, accepted the doctrine, and the Department of State never had in writing the pledge of a single power to respect the integrity of China. Whatever respect was paid to it was due to the fact that the American Government had a military establishment at Manila, a fleet in the Far East, and five thousand troops in China. The integrity-of-China policy was a policy of intervention.

Three months later came the test. Would the American Government sustain its position as to the integrity of the Empire by keeping its troops in China? The United States was in the midst of a political campaign. The Democrats were attacking the Republicans for their imperialistic policies. The Republicans were, as usually in August of a presidential year, in a funk. President McKinley, candidate for re-election, was scared. He decided to withdraw the troops. Secretary Hay protested. To Adee, the Secretary wrote:

> The inherent weakness of our position is this; we do not want to rob China ourselves, and our public opinion will not permit us to interfere, with an army, to prevent others from robbing her. Besides, we have no army. The talk of the papers about "our pre-eminent moral position giving us the authority to dictate to the world" is mere flapdoodle.*

President McKinley persisted in his policy. By the end of the year the troops had been reduced 60 per cent, and a few months later they were reduced to a legation guard. The policy of American intervention in China had been abandoned. Why? Because the American people would not support it.

Public Opinion Contrary to Intervention

From 1902 to 1932, thirty years, the pattern has been repeated with almost mathematical regularity; first intervention, then withdrawal; interference, non-interference. In each instance it has been the apathy or the hostility of American public opinion that has led to the abandonment of the policy of interference. Americans are a funny folk. They applaud lofty moral sentiment but they are rarely ready, outside of the Western Hemisphere, to take the next step, to make effective the sentiment which they applaud. The time comes when they are asked to put up or shut up. They do neither. They will not put up the force without which sentiments in this wicked world are still sentiments only, but neither will they shut up. They keep on talking about the sentiments as though wishes were horses.

In 1922 the American Government took a step which rendered a policy of intervention in Asia impossible for fifteen years, and very difficult thereafter. The motive appears to have been that American interests in the Far East, while considerable, were not worth fighting for. If they could be conserved by agreement, well and good; if not, at least they were not worth the cost of preparedness to defend them.

We have just been passing through another chapter in this spasmodic policy in the Far East. Again we have embarked upon a policy of intervention, with high moral sentiments, the defense of the peace machinery. The American people have responded as they did to John Hay's Notes on the Open Door. But soon will come the test: shall we put up or shut up? Probably we shall again do neither.

Indeed, the test has already come. What other meaning can be read into the passage of the Hawes-Cutting Bill over the President's veto than that the American people are apathetic to a policy of intervention? And if four Presidents cannot secure an affirmative vote in the American Senate for even so mild a measure as American entry into the World Court with five reservations and two understandings, what prospect is there that the people who elect those Senators will adopt more effective measures to sustain in the Far East the interventionist policy of the last Administration?

I do not argue on one side or the other as to the rightness or wrongness of the policy. Sometimes I think such words are indecent on the lips of historians. I merely point out that we are following a pattern already old in the Far East.

Explanation of Policy of 1898-1902

May I return very briefly to the policy of 1898-1902. I have already pointed out how the American people responded to the first intervention in the Far East as a great ethical policy. We would free the downtrodden Filipinos from the blight of the Spanish rule and the Roman Catholic friars. We would "save China." I have already hinted that there was another motive, represented by the fact that the Open Door Notes were suggested by an Englishman, and served, as Mr. Adee pointed out, to safeguard more British chestnuts than American. I should like to follow this a little farther.

Many times in the last twenty years, efforts have been made to prove that, at the turn of the century, the American Government made secret engagements with Great Britain which looked in the direction of an alliance. There was such an engagement in 1905 with Japan, though not directly with England. In 1898-1902 there was no such agreement in written words, but I call your attention to what happened.

When John Hay returned from the Court of St. James in September, 1898, his major problem was to secure the retirement

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*Dennis, A. L. P., *Adventure in American Diplomacy 1896-1906*. New York: Dutton and Co., 1928, p.258.

of England from the Caribbean. The American Government had determined to become in that area the paramount power. This purpose was accomplished in the next three years. England was displaced in a region where she had exerted the paramount political influence for many generations. It is not a principle of British statecraft to give up something for nothing. Where there is a *quid*, you may always expect to find a *quo* if you look hard enough. What, then, did England get in return for her retirement from the Caribbean ?

The answer is fairly obvious. The United States could *yield* nothing to England. The Irish and German voters would have punished any political party that would have made such a concession. "Take and no give" is always the maxim of a foreign policy under democratic control.

The McKinley Administration could give nothing to England, but it could retain the Philippines—an advantage to England ; it could write the Open Door Notes, a second advantage to England ; and the note of July 3, 1900, about the integrity of China. Beyond that point it could not go. It could not maintain in China a military force to join with England in opposing Russia ; but before this became evident, England had returned the compliment by yielding to the United States in the Caribbean. England got out of the Canal area ; the United States got into the Far East. There was no secret agreement, but rather merely an extraordinary coincidence of events in two widely separated parts of the world.

The association of these two political changes seems to supply the facts by which the original American policy of intervention is to be explained. Our Far Eastern policy was, in fact, a part of our Caribbean policy. Our interests in the Far East were not exclusively humanistic or chivalrous. We got something material in return.

Reasons for American Intervention in Manchuria

Now let us come back to the Far East of 1933. What interests of the American people are to be served by a revival of the policy of intervention in Manchuria ? There are two answers being offered to this question.

The first answer is that of Colonel Stimson, that if the so-called peace mechanisms devised in recent years can be sustained and vindicated, the American people may expect to share in the benefits with all the world. That explanation is very similar to the one which was offered more than thirty years ago, that if the open door and integrity of China could be maintained, the world would be spared another war and Americans would share in the benefits of peace.

The second explanation of our most recent policy of intervention is that we have a material interest in the markets of Asia, which must be conserved and protected. This explanation also has a familiar ring. It was offered in 1898, 1899, and 1900. In those days, however, there was a second material interest—in the Caribbean—which far outweighed any actual interests in the markets of Asia. The latter were for the American merchant more prospective than real. The same answer may be given to-day as to the markets of Asia, while we have to confess that there is nothing to-day to add to the trade advantage comparable with what McKinley and Hay obtained when England yielded to the United States in the Caribbean. It was therefore easier to defend the Hay policy on grounds of actual material interest than it is to defend the Stimson policy. In those days the Americans received not only prospective benefits but valuable considerations in hand.

The Issue Defined

It has not been my purpose to follow this line of thought farther than to catalogue the two policies of intervention and non-intervention in the Far East, and to add to history some minor footnotes which are now available for the first time. Nor is it necessary to carry the thought farther. There are still the arguments for intervention, and the other arguments which led the American Government in 1922 to ratify the non-fortification agreement with Japan and thus cast their lot against intervention. You may take your choice. I merely ask, therefore, that whichever be the choice, you do not confuse the categories. The policy of the open door, of the integrity of China, and its newer cousin, the non-recognition of "any situation, treaty, or agreement which may be brought about by means contrary to the Covenant and obligations of the Pact of Paris," while apparently as pacific and humanitarian as the Sermon on the Mount, are in fact no more so than the Bill of Rights and the Declaration of Independence, for both of which much blood had to be spilt.

If, on the other hand, you support the Stimson policy because it seems calculated to serve American material interests in the Far East, do not forget that in 1898-1902 we played for a bigger stake than now. The open door and integrity-of-China doctrines were more in the nature of slogans than of money-makers. They never yet have made many American millionaires, though they have made many American bankrupts and paupers. But we did win something—the paramount position of the United States in the Caribbean. What comparable actual material interest may we expect to win to-day ?

The Geology of Shanghai

By ALEXANDER MATHESON, A.M.I.T.P., F.G.S.

It is known geologically that Shanghai lies on a vast alluvial plain, but is devoid of surface indications, such as rock exposures. Therefore, a knowledge of the geological strata of the earth, and at what depths they are found, is of vital importance when locating drilling sites for water.

Inland, owing to weathering, material has been washed seaward. A huge amount of silt and clay has been carried in suspension apart from the material rolling along the bottom of the river. When a river cannot transport its load, deposition takes place. Hence the alluvial plains of Shanghai.

However, this does not give us the original history of Shanghai, although the accumulated silt laid down covers a period of several thousand years. Geological estimates of its previous history show that it was above sea-level, and that the soil was of volcanic matter which after many great eruptions is now entirely dead. In the course of time the land slowly depressed and the sea crept in. Deposits are thus laid down until the shallow sea becomes filled up and the shore line gradually retreats. Then the process is repeated. Constant change is the rule, and by those processes of Shanghai in the gradual affluxion of time has evolved into an alluvial plain.

Alluvial Strata

An alluvial cone is formed of innumerable layers of coarse and fine conglomerate sands and clays distributed irregularly throughout the mass. No single stratum extends very far. The diameter is a few hundred or a few thousand feet, and the thickness a few inches to a score of feet. The alluvium of Shanghai is very widespread, but within the narrow limits is also very variable.

The fine, muddy sediments, which have at one time or another been submerged, and of a uniform character are to be found in many areas and their stratified deposits become exposed to observation on drilling.

The most urgent problem in the study of water from alluvial strata is related to the rate at which the formation will perenially supply water in specified areas.

Water obtained from alluvial strata differs from that obtained from most other geological formation. It is not the product of events occurring in remote ages, which can be observed and studied at any convenient time. Therefore systematic observations should be made and records kept in every area where wells have been drilled in alluvium, so that reliable data may accumulate and will be available for interpretation in the future.

Well Logs and Their Interpretation

The stratification of rocks gives one the knowledge which is essential in the investigation of the suitability of the strata from which water may be obtained.

The data of existing well logs not being very accurate, available information is therefore indefinite as to exact strata of the various alluvial areas of which Shanghai consists.

Therefore, when sinking a well, it is of vital importance that an accurate log should be kept and samples of the various strata should be classified and the depths at which they are found. (Samples should be taken approximately every ten feet). This record of the stratification of the well should be of great assistance if further development is to take place in that area. The size of the bore hole, at what depths the casings are to be set, also the placing of the screen pipe and at what depths analysis of the water should be taken have to be considered.

Well Drilling

Choosing a Rig: When a site has been selected it is necessary to choose the type of rig for drilling (the location of the well should be close to the spot where the water is used, because there would be less risk of contamination after it is brought to the surface than if long distribution pipes and large storage reservoir are used). There are two types of machinery suitable for drilling through alluvial strata (The Standard Tool System and the Hydraulic Rotary System).

The Standard Tool System: By this method the drilling bit is raised and lowered and by impact on the strata, drills through them. The drilling tool has a valve above the bit. In the act of striking the valve is forced open, and by repeated lifting and dropping picks up the strata. The advantage of this system is that an accurate sample of the stratum can be got at any depth which is not so with the Hydraulic Rotary System, this is a matter of great importance in alluvial strata.

Hydraulic Rotary System: In rotary drilling the hole is kept full of circulating water, therefore it is impossible to get an accurate sample of the stratum also it muds off the possible water structure. This method is faster than the Standard System, and only one size of casing is needed, whereas on the Standard Tool System two or three sizes of casing must be used according to the depth.

Casing Sizes in Wells: The size of casing used in a water well locally is generally 2-in., 4-in., 6-in., 8-in., and 10-in. diameter. From a larger size of casing a greater production of water can be obtained. The casing used in water-wells should be made of galvanized tubing and should submit to an internal hydraulic pressure equal to 600 lb. per square inch.

Well Screen: Is the " business end " of the well, therefore, it is essential to take an accurate sand analysis at the depth at which the screen is to be set, so as to ensure that the requisite capacity of the well is attained.

It is impossible to gauge the approximate depths of any alluvial strata and at what depth to set the screen for water but it has been proved that the water locally obtained is bacteriologically pure at a depth of 500 feet to 700 feet below the surface and that the water is always of the same temperature and never freezes. The average temperature of well water in Shanghai is between 66°F. to 70°F.

The length of the screen in a well varies according to the quality of the strata in which it is to be set.

The screen must permit the fine sand particles immediately surrounding it to be pumped out with the water while the well is being developed, leaving only the coarse material to remain and form a natural gravel bed around it, also the screen should be non-corrosive if the well is to function adequately.

Compressors and Well Pumps

There are two methods of pumping water from drilled deep wells, not considering the antiquated plunger pumps, viz: with compressed air and with the so-called borehole pumps which are specially designed vertical multi-stage centrifugal pumps.

When pumping with compressed air, the well casing is used as the eduction-pipe and a smaller pipe in it delivers compressed air below the water level. The rising column in the pipe consists of air mingled with water, this mixture, being lighter than water, will consequently rise to higher level than the surrounding water. The compressed air must be filtered and cleaned from oil so that it will not contaminate the water. The water with compressed air is usually raised into a tank on the ground level, where the water is deaerated and from there an ordinary centrifugal pump delivers the water into elevated tanks or pressure system.

The over-all efficiency of air-lift pumps is seldom higher than 30 per cent. Such low efficiency being mainly due to low volumetric efficiency of compressors and to high friction losses of the air-water mixture which is approximately six times greater than the friction of the water flowing at the same velocity. The decided advantage of air-lift pumps is that the equipment can be conveniently placed at a distance from the well the site of which therefore, can be located to the best advantage.

Borehole pumps have a great advantage over air-lift pumps in respect to higher efficiency as they are directly driven by vertical shafts from vertical electric motors and pumping efficiency of 50 per cent—75 per cent can be attained. Borehole pumps will raise water from a practical depth to a practical height in a single operation eliminating the necessity of surface tank and additional booster pump. Borehole pumps, however, can be installed only where it is permissible to install the driving electric motor above the well casing. The latest design of borehole pumps embodies water lubrication, i.e., the bearings supporting the vertical driving shaft are made of material suitable to be lubricated by the water itself that is pumped. This feature assures oil free water and reduces considerably the necessary attendance for keeping the equipment in good order.

In conclusion it is safe to state that deep wells equipped with high efficiency borehole pumps are of advantage to consumers of great quantities of water, the more so if the water is consumed at an even rate without peak loads to be taken care of by storage tanks. In the latter case the equipment includes automatic control which, in connection with the storage tanks, takes care of the variations in consumption.

With a knowledge of the geology of Shanghai and its well drilling methods for water, water should be obtained in abundance. The main item from the consumer's point of view is the consumption and its continuous supply and its cost. Owing to the bacteriological water bearing sand being at various depths in the area of Shanghai, the following points should be taken into consideration: The amount of water needed, the size of the borehole, the length of the screen pipe, the type of head-gear needed for drawing and pumping of water. Deep well waters in Shanghai area are extensively used for both domestic and industrial purposes and the quality of such water generally answers to both requirements.

Huge Flour Mill Extensions

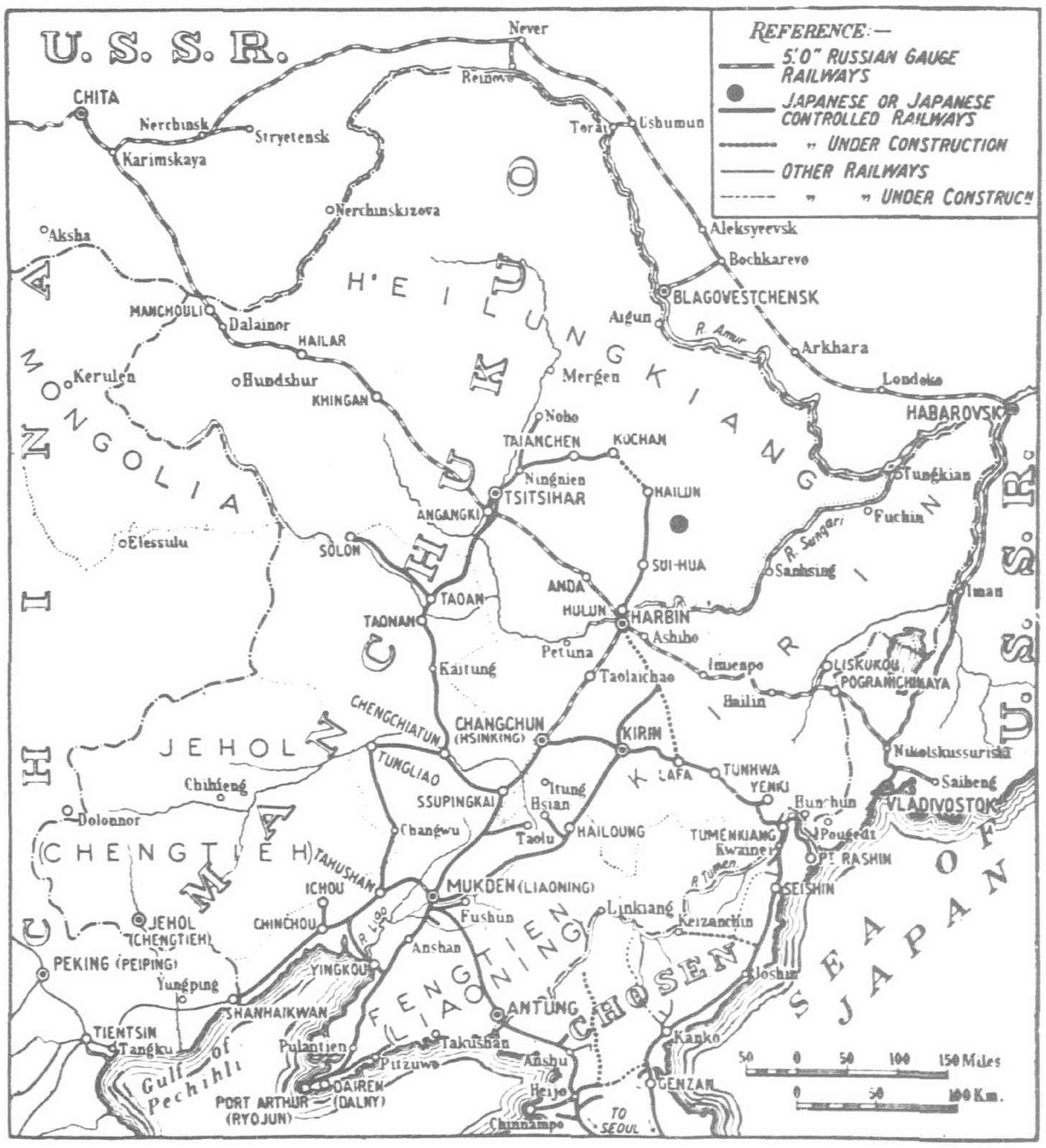
Japan's flour industry may soon be bothered with overproduction, since many mills have been increasing their capacities. The Masuda Mill in Kobe is erecting a 500-barrel mill at Shinkoyasu, in Kanagawa Prefecture. The Nisshin Flour Mill will raise the capacity of its Tsurumi plant by 2,000 barrels this month, and by 2,000 barrels more in September. When the Tsurumi plant is complete it will be able to turn out 12,000 barrels a day and will be one of the largest in the world. The Nankosha, in concert with the Shimoshima Flour Mill Company, has decided to erect a 500-barrel mill between Tokyo and Yokohama, and has already ordered the machinery from Germany. The Ministry of Agriculture and Forestry is also subsidizing farmers to buy small motors to mill their own wheat flour. More than 2,000 such motors have been purchased, and these will turn out 3,000 barrels a day. It thus appears as if Japan's flour milling capacity would be increased 8,000,000 barrels between December, 1932, and September, 1933. This means 16 per cent of the present daily capacity of 48,920 barrels or 195,680 sacks (or about 71,423,000 sacks a year). Last year Japan produced 41,979,000 sacks of flour, of which 32,003,000 were consumed at home and 9,976,000 were exported.

The Manchurian Railway System*

In consequence of the South Manchurian Railway having, by arrangement with the Manchoukuo Government, taken over the management of all the railways in Manchuria, with the exception of the Chinese Eastern Railway, an extraordinary general meeting of the company was recently held in Tokyo, for the purpose of altering the articles of association, and obtaining sanction for the issue of new capital.

Of the 3,600,000 new shares of Y.100 each, 2,200,000 have been allocated to the present shareholders, 200,000 to the company's servants, and the remaining 1,200,000 offered for public subscription, the total capital, including the new issue, totalling Y.800,000,000. On the formation of the South Manchuria Railway in 1906 the capital was Y.200,000,000, and by 1920 it had risen to Y.440,000,000, half of which was held by the Japanese Government.

The taking over of the various lines in Manchuria by the S.M.R. has been found convenient, both by the State and by the company, in settling the enormous liabilities and loans, totalling Y.130,000,000, which Manchoukuo is under an obligation to repay, or has incurred in favor of the S.M.R. in connection with the following ex-Chinese National Railways:—Kirin-Changchun, Kirin-Tunhwa, Kirin-Hailoung, Ssupingkai-Taonan, Taonan-Angangki, Taonan-Solon, Tsitsihar-Kochan, Hulun-Hailun, Mukden-Hailoung, and Mukden-Shanhaikwan. The properties and revenues of these lines are to form the security for the loans and liabilities, and the management has been entrusted to the S.M.R., who, to cope with the increased mileage of their system, have created two new Boards: the Construction Board, and the Railway Board. The former has three general offices, and four construction offices located at Kirin, Harbin, Tsitsihar and Rashin, while the Railway Board is divided into six departments, including a patrolling office, which looks after the policing of the Railway Zone.



Sketch Map of the Railways (and their gauges) of Manchoukuo

All claims and debts existing between the Manchoukuo Government and any third party concerning any of the above-mentioned railways, will be settled by the S.M.R. in consultation with the Government, the company having agreed to pay out of the revenues derived from the management of these railways. The Mukden-Shanhaikwan Railway, which previously formed part of the Pekin-Mukden Railway, is under an obligation to repay various loans to the British and Chinese Corporation, and is to be excluded from the security of the present contract until the question of settling the loans has been discussed.

The Manchoukuo Government has also concluded a separate contract with the S.M.R. for the construction of new lines from Tunhwa to the River Tumen, from Harbin to Lafa, and from Taianchen to Hailun, the total cost of construction amounting to approximately Y.100,000,000; the Taianchen-Kochan section is now completed. In connection with the Tunhwa-River Tumen Railway, it has been necessary for the State to purchase the existing Tunhwa-Tumen Light Railway, and for this purpose has borrowed Y.6,000,000 from the S.M.R. The construction of the Tunhwa-Tumen line has been completed and regular operation was commenced in August after the signalling and stations were finished.

In addition to new lines, the present program includes the construction of 2,000 steel freight cars at the Shakako (Dairen) shops, and the reconstruction of the Ranan Harbor at Rashin, and the construction of a new 200 meter bridge on the Taonan-Tsitsihar section, the contract for the last named having recently been awarded to a German firm at a price of Y.2,200,000. The unification of passenger rates throughout the country is also being given a great deal of attention, as the old Chinese National lines each had a scale of their own.

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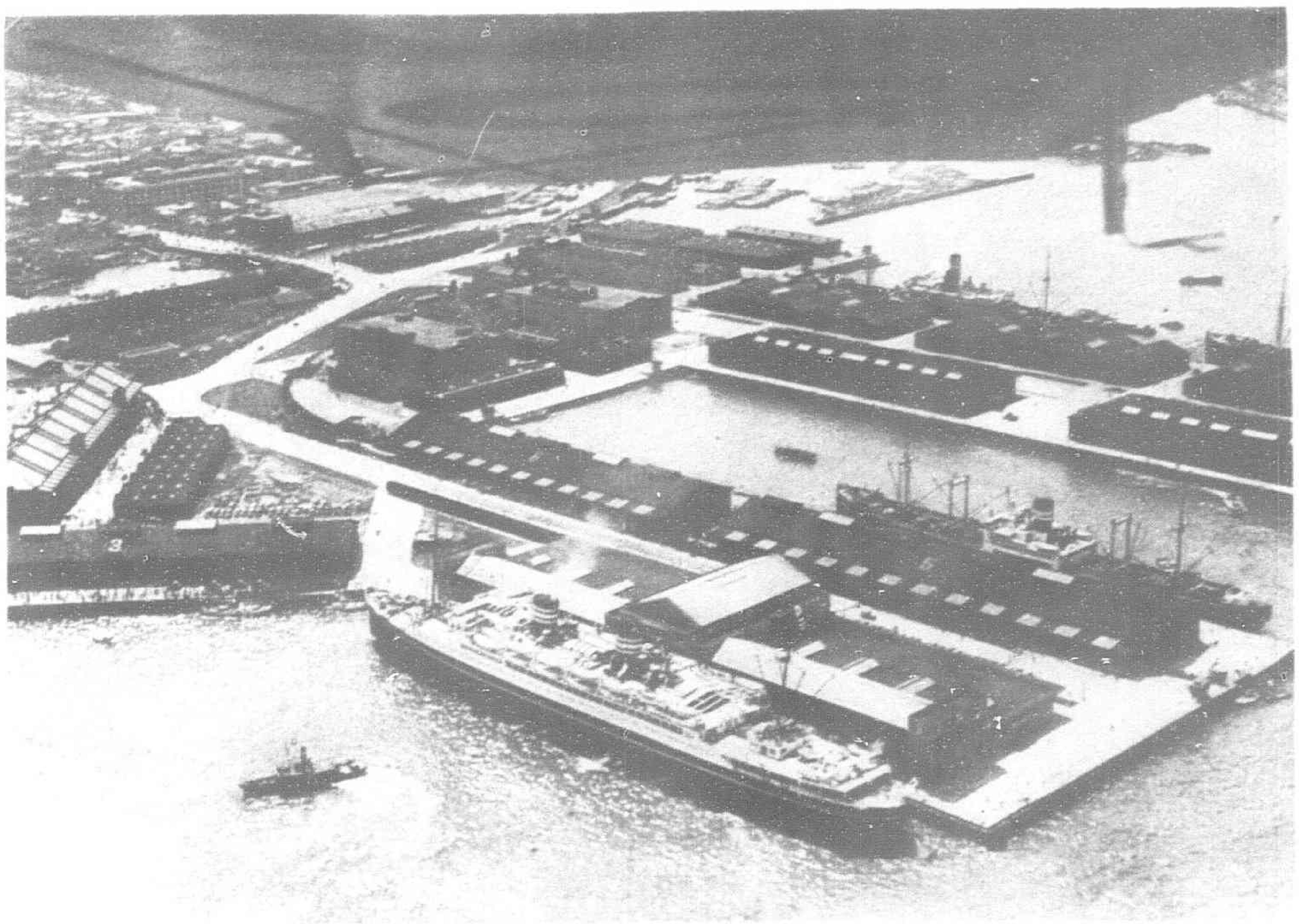
*The Railway Gazette.

Manchoukuo Oil Schemes

Manchoukuo is reported to be making plans for the erection of an oil refinery at Hulutao, the new port which Manchoukuo hopes to develop. This plant will have a daily capacity of 4,000 barrels of gasoline, and may commence operations with imported crude oil, probably from Russia. In the neighborhood of Hailar there are crude oil seepages and geologists are there to prospect and prepare for drilling this summer. If oil is brought in paying quantities, another refinery may be built at Hailar. There are said to be two most important and promising oil fields in Manchoukuo. One is near Chiufutan in Jehol Province. About 30 years ago the Standard Oil Company made boring tests there. The other field is at Dalainor, not far from Manchuli. Both Soviet and Chinese experts have looked over this field, and just before the Mukden incident of September 18, 1931, the South Manchuria Railway Company planned to sink some test wells there. Now it is understood that drilling will start at once.

Commercial Aviation in Japan

By W. HARVEY CLARKE, Jr.



View of Yokohama Harbor from a Japan Air Transport Plane

Practical commercial aviation in Japan is of quite recent origin when compared with the much longer established air lines of Europe and America. A short half decade, since October, 1928, covers the time during which travel by air has gained a considerable degree of popularity within the Empire.

Five organizations providing regular, scheduled air service exist to-day in Japan: and of these the principal one is the Japan Air Transport Company, Ltd. (Nippon Koku Yuso Kabushiki Kaisha), which began its period of activity on October 20, just five years ago. This company operates air lines totaling 2,830 kilometers, and extending from Tokyo to Tsitsihar in Manchoukuo.

Jat lines owe their inception directly to a government subsidy for air transportation amounting to Y.19,970,000, appropriated at the 55th session of the Imperial Diet in May, 1928, at which time it was decided to distribute this sum of money over a period of 11 years beginning with the fiscal year 1928-29 for the sole benefit of the projected organization. By means of this financial support, the Jat company came into being with a capital of Y.10,000,000 as a public carrier of passengers, mail and freight by air. In March, 1932, which ended its fourth fiscal year, the paid up capital of the company was Y.7,000,000.

The President of the Jat lines is Mr. Kunizo Hara, and the Managing Director, Mr. Masadi Togawa. Some of the directors, who are prominent in Japanese business circles, are: Messrs. Katsutaro Inagaki, Shintaro Ohashi, Eisaburo Okawa, Kaiti Nezu, Seibei Kawanishi and Bukiti Matsunaga. The Auditor, Mr. Keizaburo Hashimoto, is also President of the Nippon Oil Company, Ltd. As chief engineer of the Jat lines, Capt. Kenkiti Syodi is well known in Japan for his ability in aeronautics. Other members of the company's official staff include Messrs. Izusaburo Obata, Technical Chief: Hirosi Abe, Operation Manager: Saburo Morikawa, Inspection Manager: Hokao Saito, Enterprise Director: and Tatudi Sasiyama, Supervisor of General Affairs.

In Japan proper, Korea and in Manchoukuo the Jat organization uses government airports, radio communication facilities, and avails itself of official weather bureau reports. Yet their own waiting rooms for passengers, offices and hangars have been built at the various airports in use.

Exactly a year after the company was founded, a Jat landplane made its first service flight on April 1, 1929, from Tokyo to Osaka. Thus was instituted the first link of Jat airways with 12 round trips a week. The succeeding link between Osaka and Hukuoka on the Island of Kyushu is operated with six round trips weekly, and that between Hukuoka, Urusan (Korea) and Dairen provides three weekly round trips.

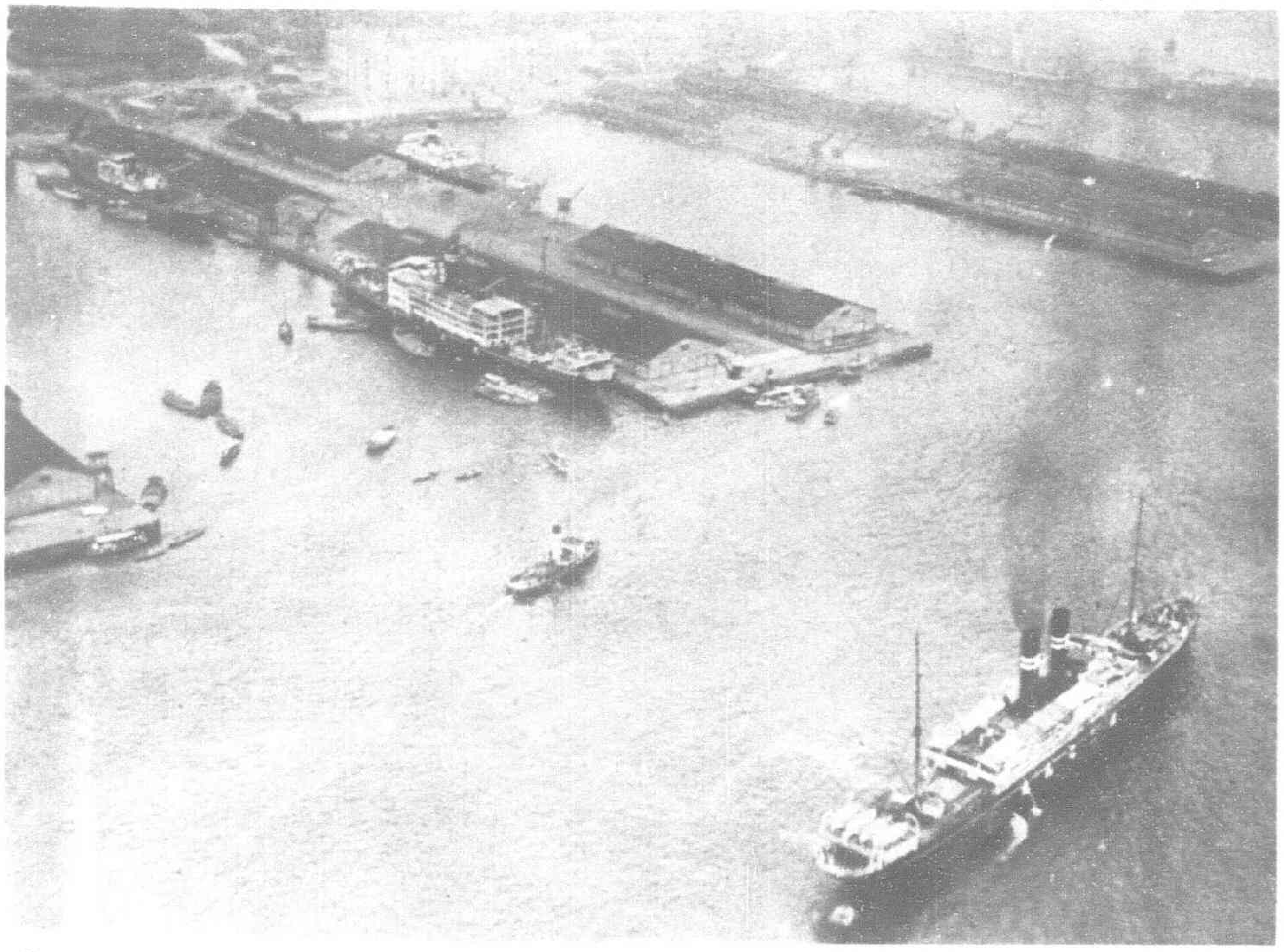
To link up the Japanese islands with Korea and South Manchuria the Hukuoka to Urusan service was begun in June, 1929. In the following month of that year an oversea route between Osaka and Hukuoka was opened, and the same month a 12 round trip passenger service was commenced between Tokyo and Hukuoka. In September of the same year a passenger service was opened between Hukuoka and Dairen with six round trips weekly. A regular mail and freight service has also been maintained between these points.

A number of test flights were made between Hukuoka and Shanghai late in 1929, but a regular service is not yet established. In 1930 the Tokyo-Korea service increased in efficiency so that connection at both ends was made possible within a day's time.

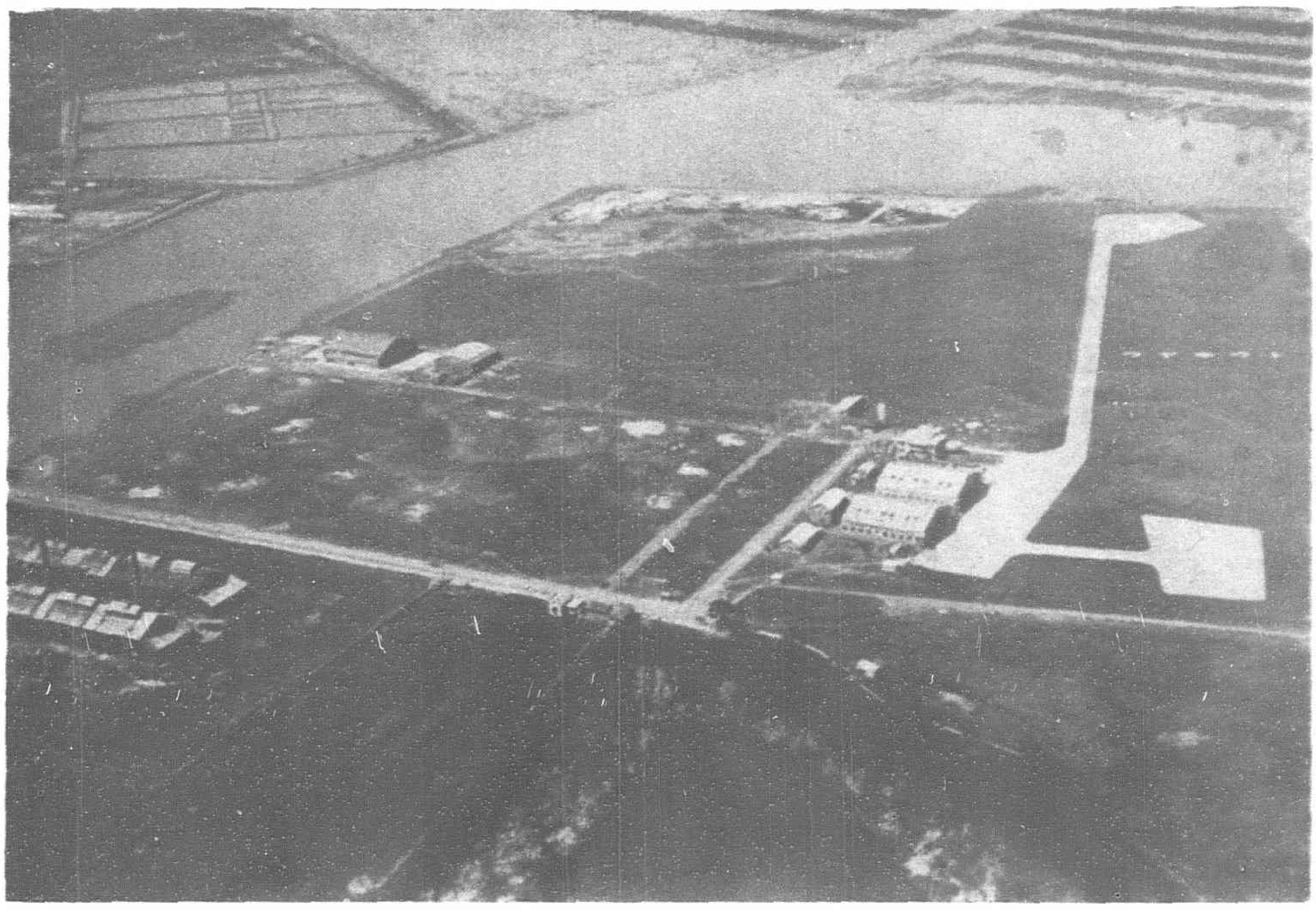
About 20 miles west of downtown Tokyo is the Tachikawa airport, which was made use of by the Jat company until July, 1931. Now the Tokyo terminus of the Jat lines is at the Haneda airport less than half that distance from the heart of the city. Furthermore, it is situated between Tokyo and Yokohama, and therefore makes it convenient for travelers from both cities.

Jat flights during the year 1931 covered 878,361 kms. (545,787 miles) for regular scheduled runs and 435,323 kms. (270,497 miles) for other flights, which totals 1,313,684 kms. (816,284 miles). This figure represents an increase over 1930 of 198,946 kms. (123,619). The regular service operation represents 93 per cent of the figure for arranged flights.

For the fiscal year ending March 31, 1931, receipts, in comparison with the previous year, showed an increase of 73 per cent for the transportation of mail, a decrease of 5 per cent for freight carriage and an increase of 16 per cent in passenger traffic.



Portion of the Important Kansai Harbor at Kobe in Central Japan as seen from a J.A.T. Plane.



Aerial view of Haneda Airport, Kamata Ward, Tokyo

To-day regular service flights are made between the following points :

Tokyo	425 kilometers	12 round trips weekly.
Osaka	500 ,,	6 round trips weekly by land route.
		12 ,, ,, ,, sea ,,
Hukuoka	240 ,,	6 round trips weekly.
Urusan	310 ,,	
Keizyo	200 ,,	
Heizyo	160 ,,	
Singisyu	273 ,,	
Dairen	355 ,,	
Mukden	275 ,,	
Hsinking	235 ,,	
Harbin	275 ,,	
Tsitsihar		

The Jat air fleet is composed of more than 40 planes of various types for overland as well as oversea service. Semi-annually each plane undergoes government inspection. An average of ten planes are under constant inspection.

Types of Jat Airliners in Service

(1) Fokker " VFII " b, tri-motored landplanes with Wright Whirlwind engines, 225 h.p. each, 8-passenger accommodation and flying range of four hours.

(2) Fokker " Super-Universal," landplanes with single Bristol Jupiter motor of 420 h.p., 6-passenger accommodation and flying range of five hours.

(3) Fokker " Super-Universal," seaplanes with single Bristol Jupiter motor of 420 h.p., 6-passenger accommodation and flying range of five hours.

(4) Dornier-Wal, twin-motored landplanes accommodating eight passengers and having a flying range of nine hours.

(5) Nakajima P., mailplane for night flight, single seater with a 420 h.p. Bristol Jupiter motor.

Fokker " Super-Universal " planes are the type most in use.

The types of motors installed are :

For single-motored planes : 420 h.p. Jupiter VI of Bristol or Nakajima Aircraft Company.

For twin-motored planes : 500 h.p. B.M.W. VI of Kawasaki type.

For tri-motored planes : 225 h.p. Wright Whirlwind J.5. and J.6.

Registration of Jat aircraft is as follows:

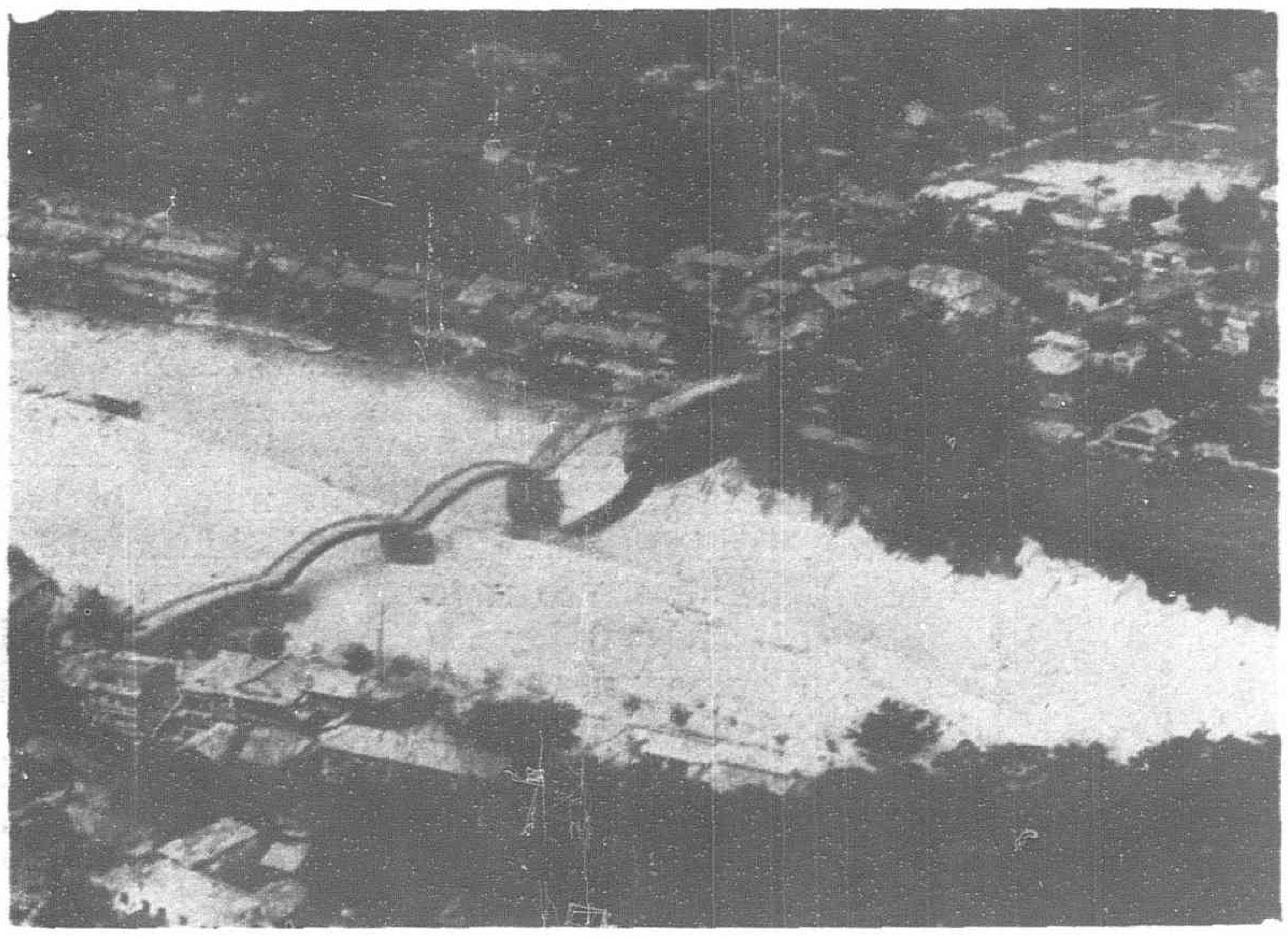
Japan Proper : J-BAAO, and other combinations of four letters beginning with " B " and ending with " O."

Korea : J-CAYO, and other combinations of four letters beginning with " C " and ending with " O."

Kwantong : (Manchoukuo) J-EJAO, and other combinations of four letters beginning with " E " and ending with " O."

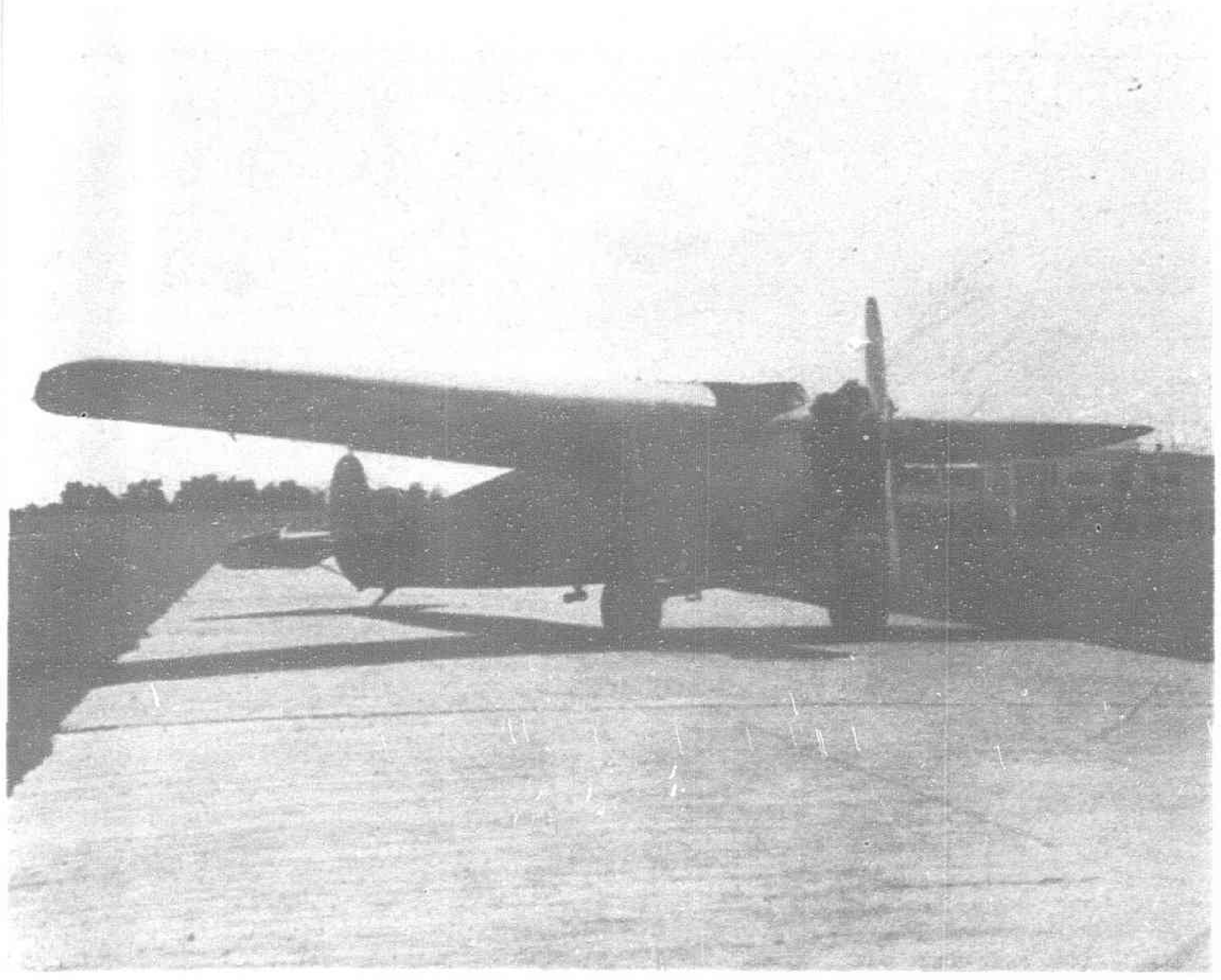
Owing to the fact that the various planes in service are continually being transferred from one line to another it is scarcely possible to give the actual lettering against those in regular operation.

Jat pilots are all carefully picked, expert fliers, each of whom must have the Department of Communications certificate. These pilots are drawn from three primary sources, namely, graduates from Japanese Middle Schools, who have undergone army or navy training ; retired officers or non-commissioned officers above the rank of sergeant from the army or navy ; and, a few pilots trained in schools of aviation and holding Department of Communications licenses.

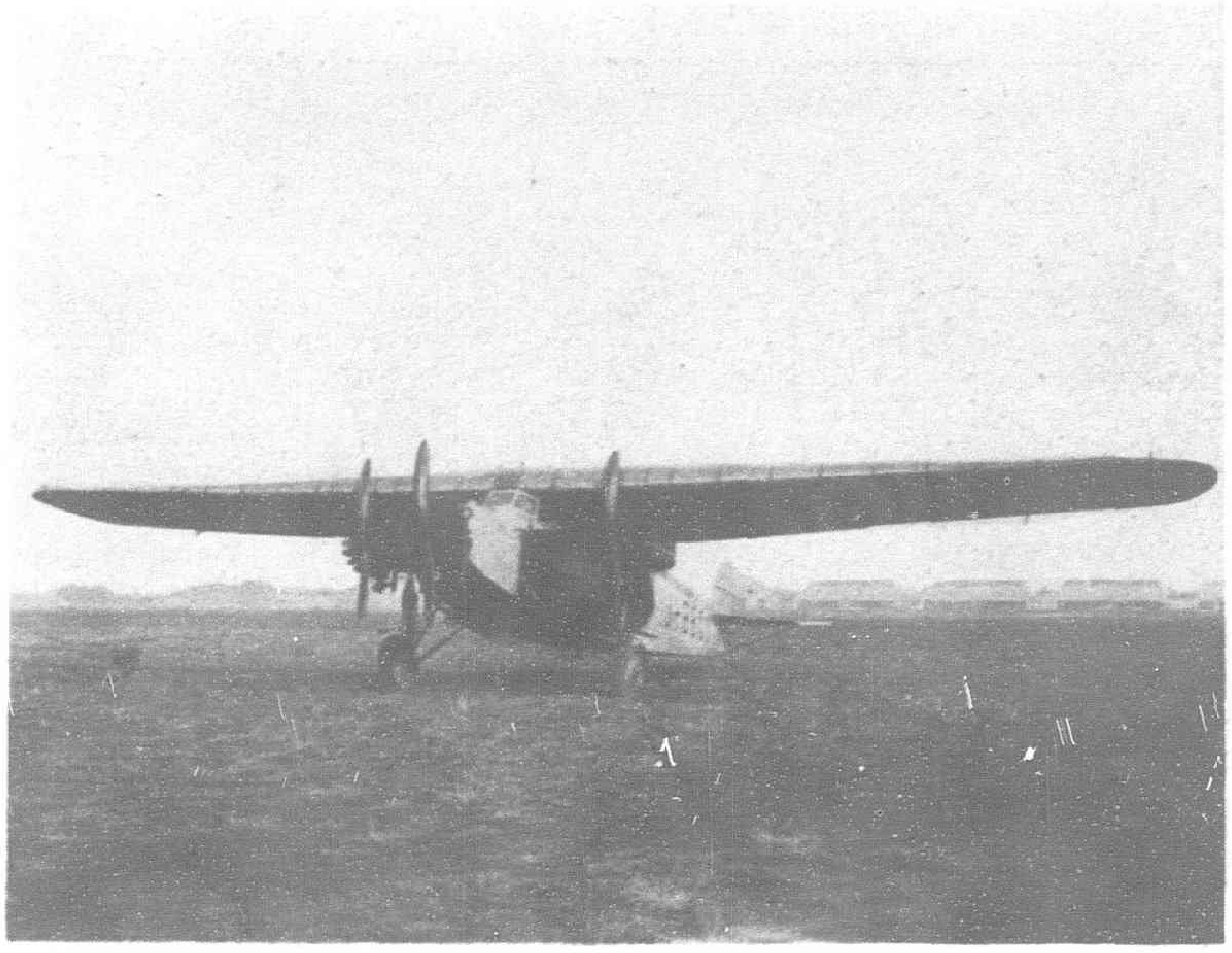


View from J.A.T. Plane Flying over Kintai Bridge, Yamaguti Prefecture

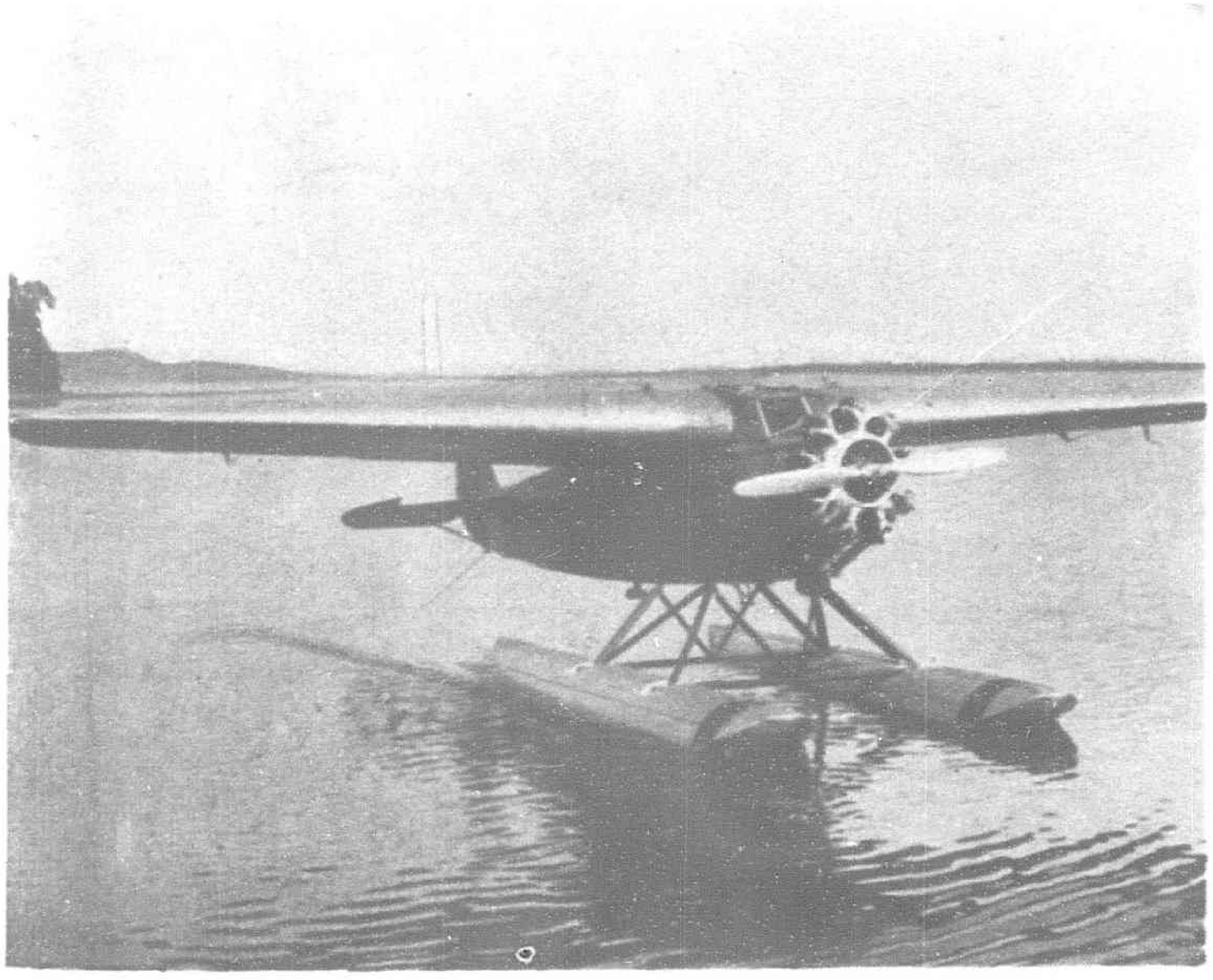
Powerful Airway Beacon on an Eminence in Hakone Pass with its 1,500-ft. Elevation Barrier to Sky Pilots



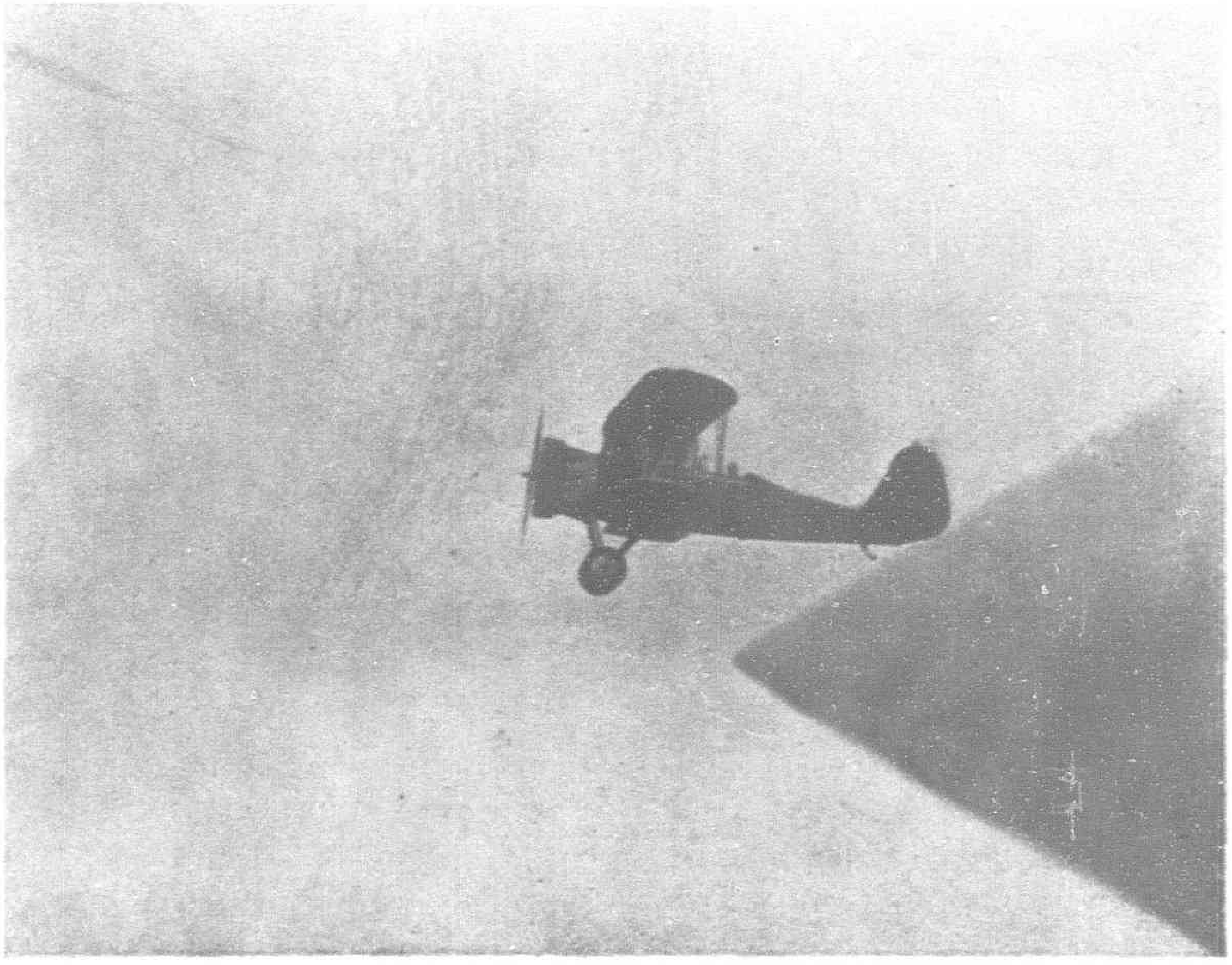
Fokker "Super-Universal" Japanese made 6-Passenger Land Plane equipped with a Bristol Jupiter 420 h.p. Motor, in the Tokyo-Osaka-Hukuoka Run, Haneda Airport



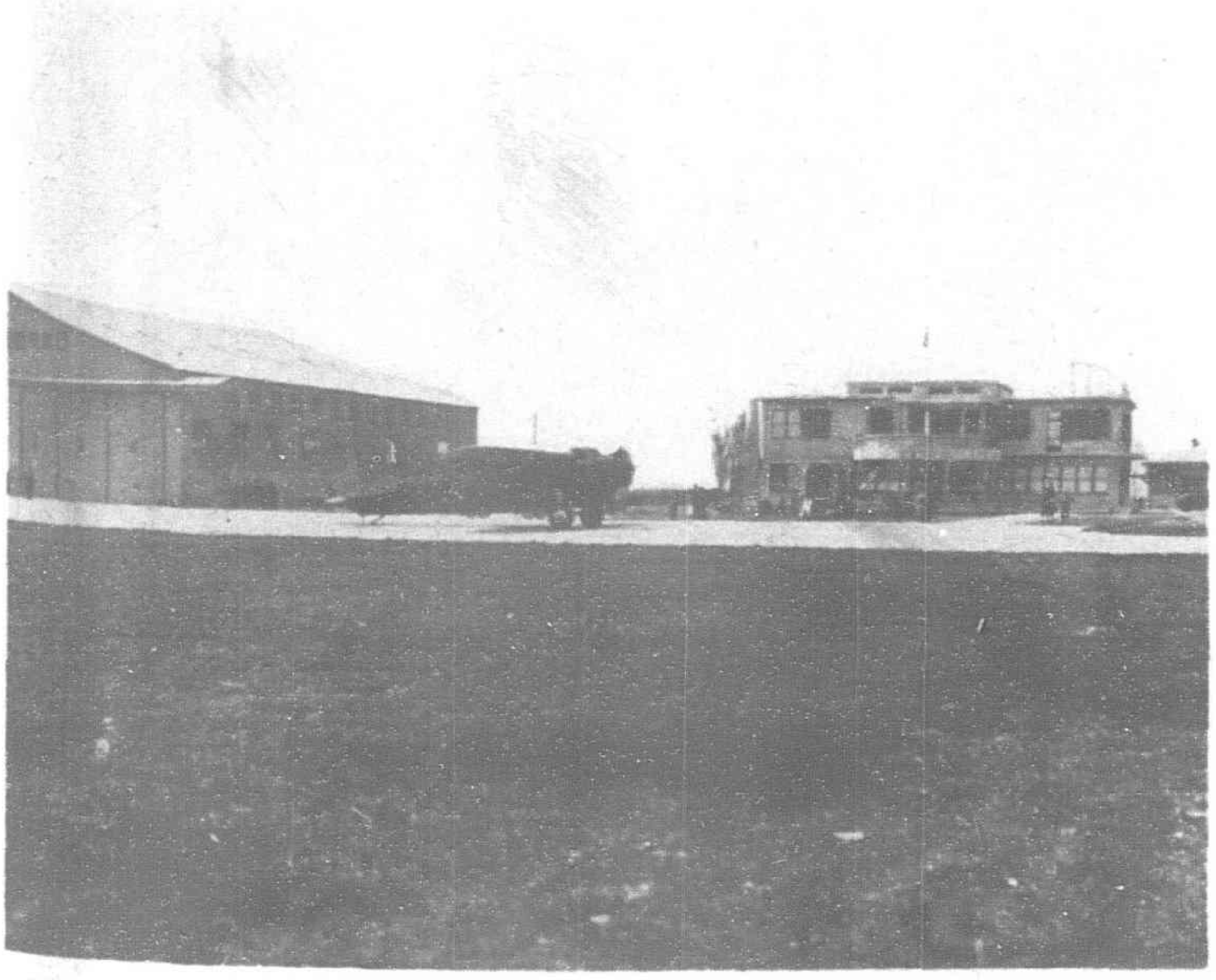
Eight-Passenger Fokker "F VII" b. Tri-motored Air Liner made in Holland with three Wright Whirlwind 225 h.p. Motors in Regular J.A.T. Service



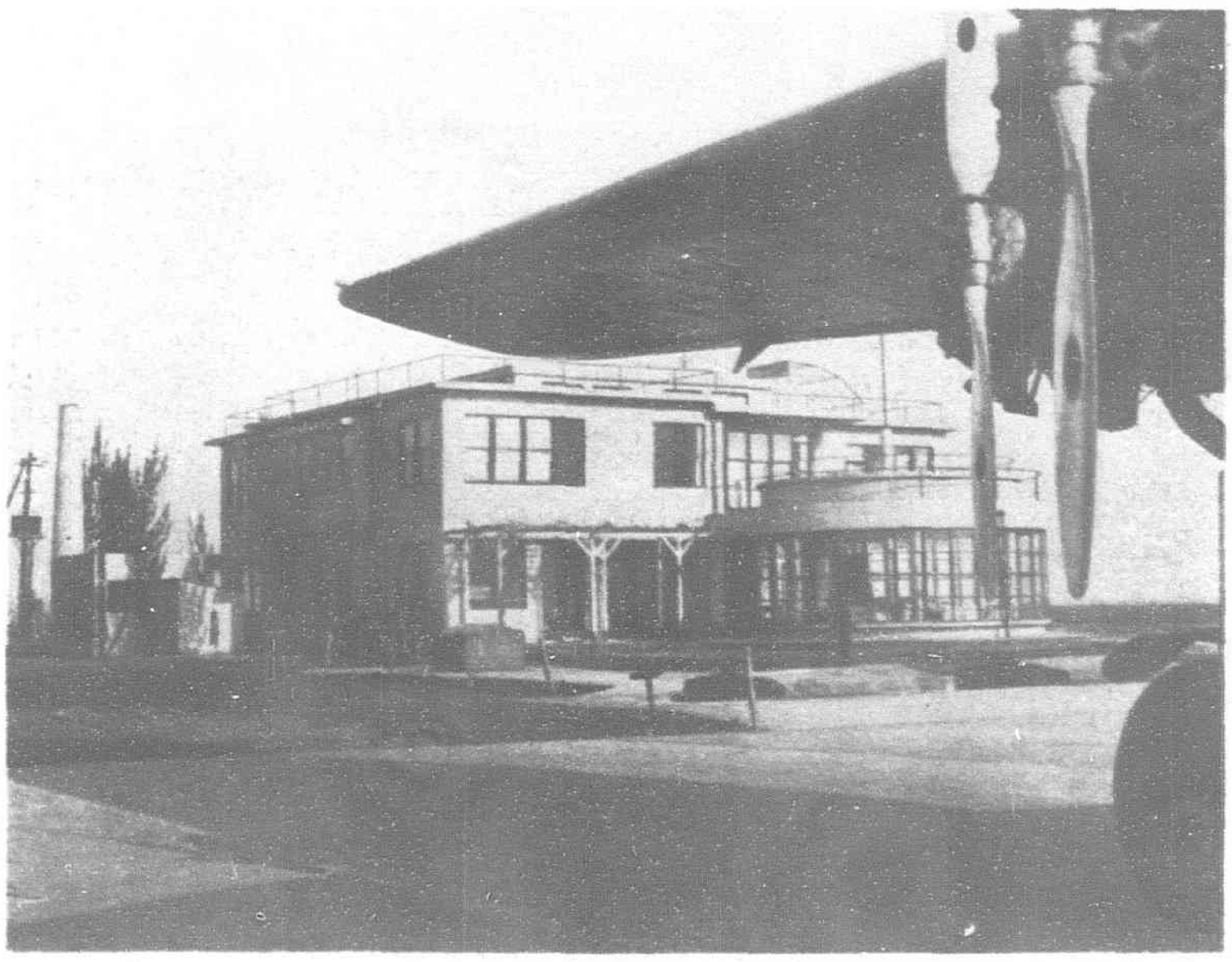
J.A.T. "Super-Universal" 420 h.p. Hydroplane made in Japan at rest in Hakuoka Harbor, Island of Kyushu



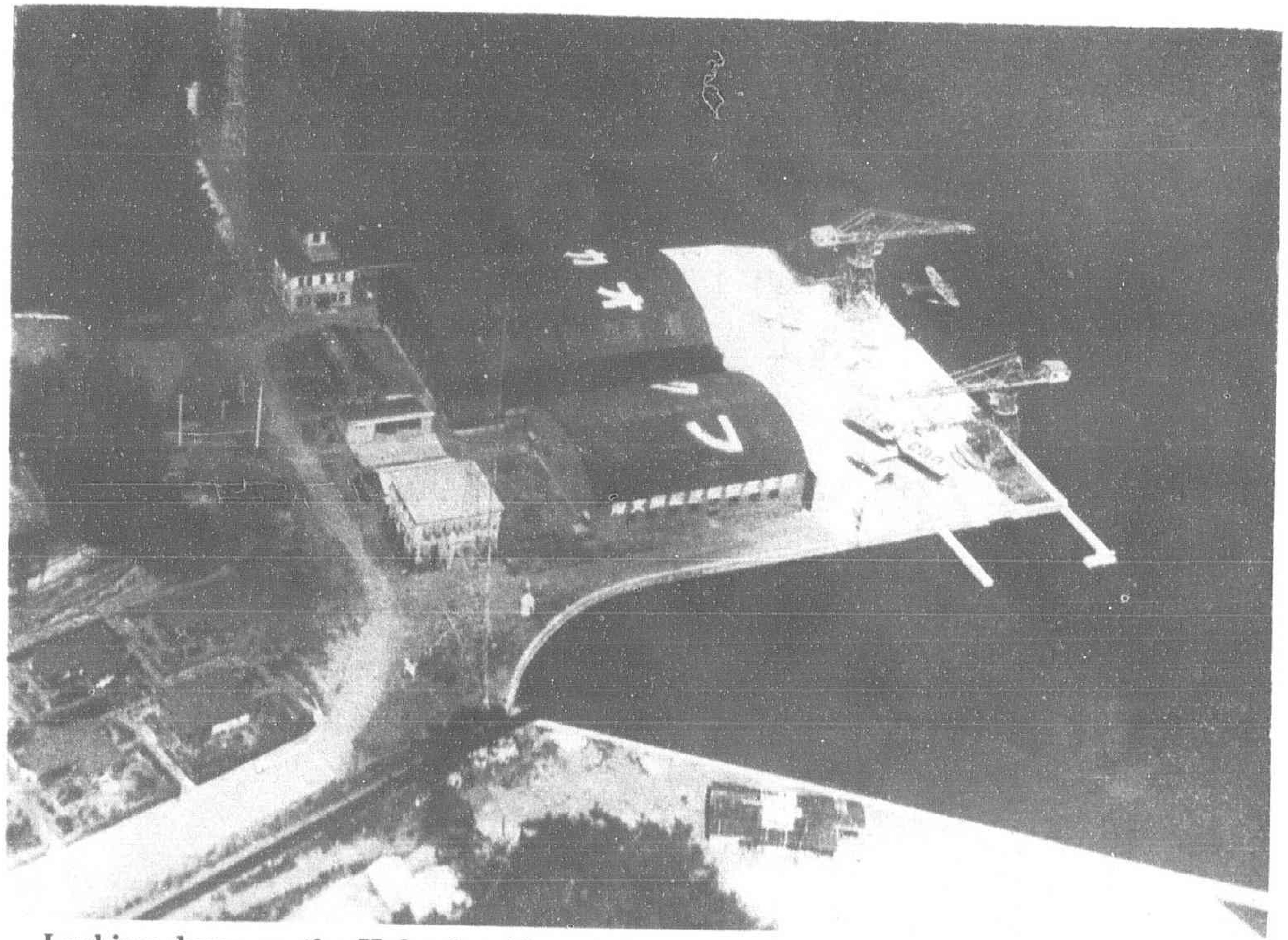
Japanese made 420 h.p. Nakajima, Japan Air Transport Mail Plane in full flight through the cloud banks near Mount Fuji



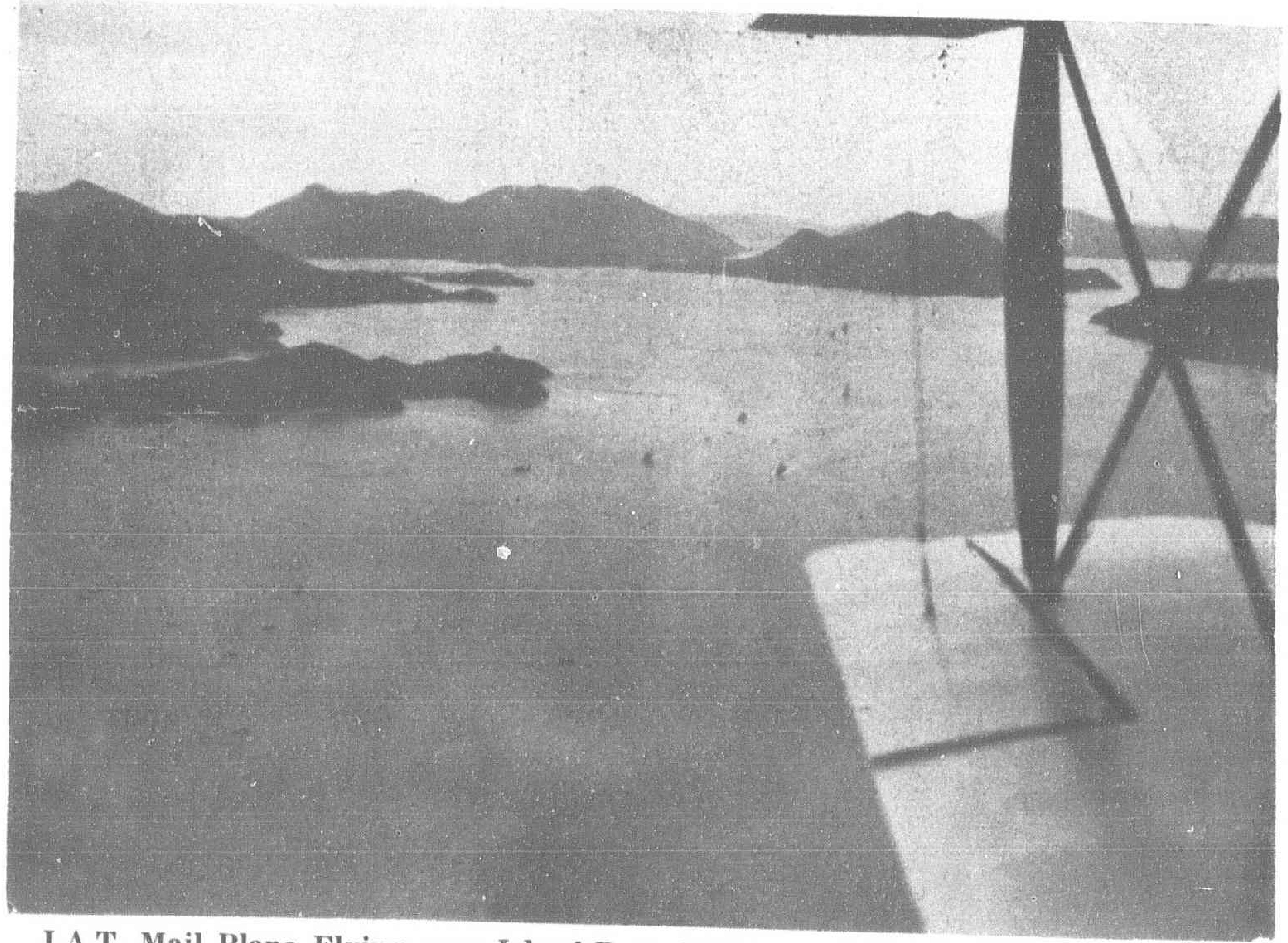
Japanese made Fokker "Super-Universal" 6-Passenger J.A.T. Liner about to Take Off from Runway at Haneda Airport. Waiting Rooms, Offices and Part of Hangars in background



Close-Up of Haneda Airport Ticket Office and Waiting Room for Passengers, Kamata Ward, Tokyo with a Tri-Motored Fokker Air Liner in foreground

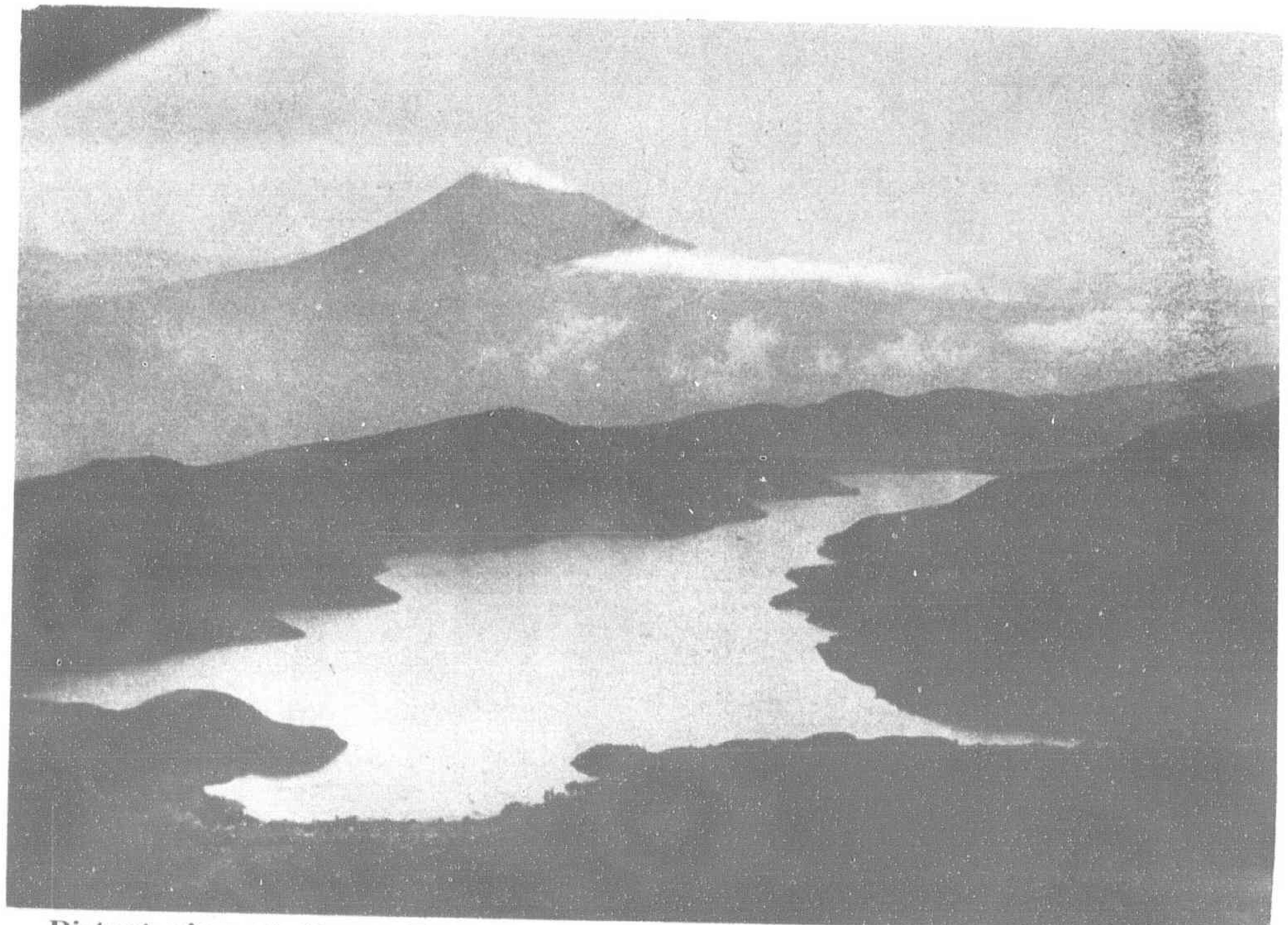


Looking down on the Hukuoka Airport from an Air Liner of the Japan Transport Company, Island of Kyushu



J.A.T. Mail Plane Flying over Island-Dotted Waters of The Inland Sea (Setonaikai), Central Japan

A Japan Air Transport Plane above the Famous Spot, Miho-no-Matsubara, Shizuoka Prefecture



Distant view of Mount Fuji from a J.A.T. Plane Soaring over Lake Ashinoko (Lake Hakone) Idzu Peninsula

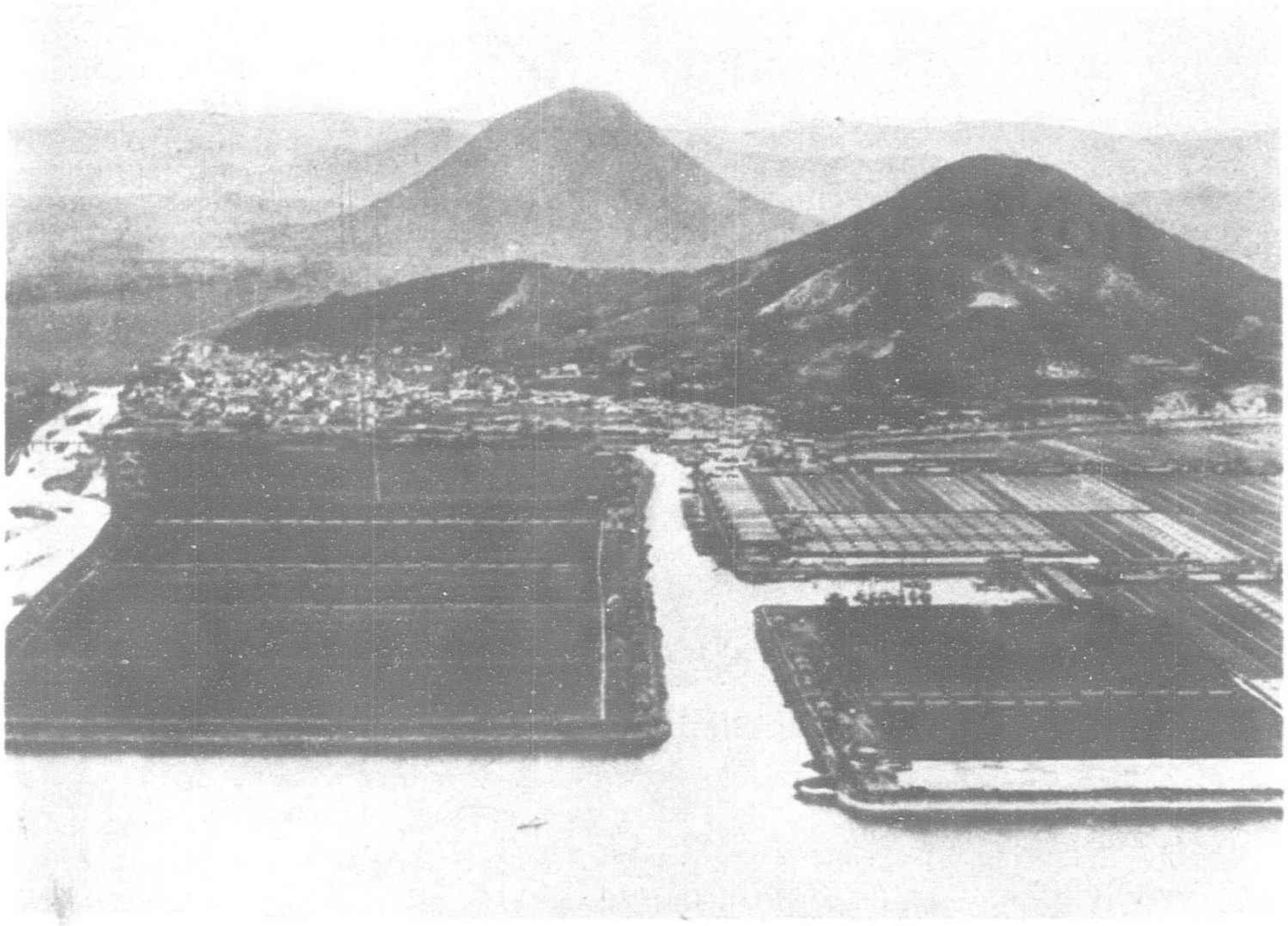
The 6-passenger, single-motored liners carry a pilot and one mechanic, while the twin-motored 8-seaters have one pilot and sometimes two mechanics besides a navigator and one radio operator. The tri-motored planes have one pilot, one mechanic and one radio operator.

Ever since the first Jat flight in April, 1929, there have been only three accidents occurring to any Jat plane. These three accidents caused the death of one passenger and eight of the crew. A single-motored plane crashed on the Island of Kyushu in July, 1930, killing a mechanic. Another single-motored plane in 1931, also in Kyushu, crashed and caused the death of one passenger and two of the crew. Then in February, 1932, the company's only hydroplane at that time, flying between Osaka and Hukuoka, crashed in Kyushu killing the crew of five, there being no passengers on board at the time of the accident. These mishaps were all three attributed to foggy weather conditions.

Charges for baggage between inland points and between Korean and Manchurian destinations are :

Up to 15 kgs.	Free of charge
Above 15 kgs. and up to 30 kgs	70 sen for each kg.
Above 30 kgs.	Y.1.00 for each kg.

Air view of the Abe River as a J.A.T. Plane flies along its Course, Shizuoka Prefecture



Taken from a Japan Air Transport Liner in full view of Sanuki Huji, Island of Sikoku

Charges for baggage between inland and Korean or Manchurian points are :

Above 15 kgs. and up to 30 kgs...	Y.1.40 per kg.
Above 30 kgs.	2.00 ,,

The inland freight rate as well as that between Korea and Manchoukuo is Y.1 for each kilogram, while the rate between Japan proper and Korea or Manchoukuo is Y.2 for each kilogram.

Late in August of this year the Japan Air Transport company proposed a plan calling for a new air line across the Korean channel to connect Shimonoseki and Fusan (Korea) using large amphibians accommodating upwards of 50 passengers. This proposal is submitted to the transportation council by the Department of Communications for consideration and the possibility of financial aid.

The Jat organization is planning to establish a regular service between Haneda airport (Tokyo) and Sapporo, the chief city of Hokkaido, the northernmost large island of Japan proper. This service will touch the cities of Sendai and Aomori, thus covering the largest centers of population in northern Japan. Additional

(*Continued on page 456*)

Jat Table of Fares and Distances

Tokyo	Y. 30	Y. 65	Y. 83	Y.105	Y.118	Y.130	Y.145	Y.147	Y.162	Y.187	Y.211
425 km.	**Osaka**	Y. 35	Y. 53	Y. 75	Y. 88	Y.100	Y.115	Y.117	Y.132	Y.157	Y.181
925 km.	500 km.	**Hukuoka**	Y. 18	Y. 40	Y. 53	Y. 65	Y. 80	Y. 82	Y. 97	Y.122	Y.146
1,165 km.	740 km.	240 km.	**Urusan**	Y. 22	Y. 35	Y. 47	Y. 62	Y. 64	Y. 79	Y.104	Y.128
1,475 km.	1,050 km.	550 km.	310 km.	**Keizyo**	Y. 13	Y. 25	Y. 40	Y. 42	Y. 57	Y. 82	Y.106
1,675 km.	1,250 km.	750 km.	510 km.	200 km.	**Heizyo**	Y. 12	Y. 27	Y. 29	Y. 44	Y. 69	Y. 93
1,835 km.	1,410 km.	910 km.	670 km.	360 km.	160 km.	**Singisyu**	Y. 19	Y. 17	Y. 32	Y. 57	Y. 81
2,108 km.	1,683 km.	1,183 km.	943 km.	633 km.	433 km.	273 km.	**Dairen**	Y. 21	Y. 36	Y. 61	Y. 85
2,045 km.	1,620 km.	1,120 km.	880 km.	570 km.	370 km.	210 km.	355 km.	**Mukden**	Y. 18	Y. 44	Y. 69
2,320 km.	1,895 km.	1,395 km.	1,155 km.	845 km.	645 km.	485 km.	630 km.	275 km.	**Hsinking**	Y. 28	Y. 54
2,555 km.	2,130 km.	1,630 km.	1,390 km.	1,080 km.	880 km.	720 km.	865 km.	510 km.	235 km.	**Harbin**	Y. 28
2,830 km.	2,405 km.	1,905 km.	1,665 km.	1,355 km.	1,155 km.	995 km.	1,140 km.	785 km.	510 km.	275 km.	**Tsitsihar**

Nanking's New Powerful Broadcasting Station

Plant is Equipped with M.A.N. Diesel Engine

With simple impressive ceremonies, the large Broadcasting Station of the Central Party Headquarters at Nanking took place a few months ago. The plant was erected and supplied by the Telefunken East Asiatic Wireless Co.

There are a limited number of Broadcasting Stations in several provinces in China, their capacity is from about 0.5 to 2 kw. They are serving a small area only. The above mentioned large broadcasting station in Nanking puts China in line with other States, owning modern broadcasting stations. The capacity of 75 kw. brings the Nanking Station in size near to the German Stations Muehlacker and Breslau. The Nanking Station has a seven-stage Telefunken Tube Sender and is working on a wavelength of 440 m.

The station has its own Power Plant, consisting of one M.A.N. Diesel Engine of 600 h.p., direct connected to one Siemens 3-phase Generator. The Diesel motor is of solid injection, trunk piston, 4-cycle type. It is of the well known M.A.N. Gvu design, of which similar types of many thousands of horsepower have been supplied not only in China, but in all other countries of the world. Everywhere, motors of this type, are working to the fullest satisfaction of their owners. The characteristic features of this design are:

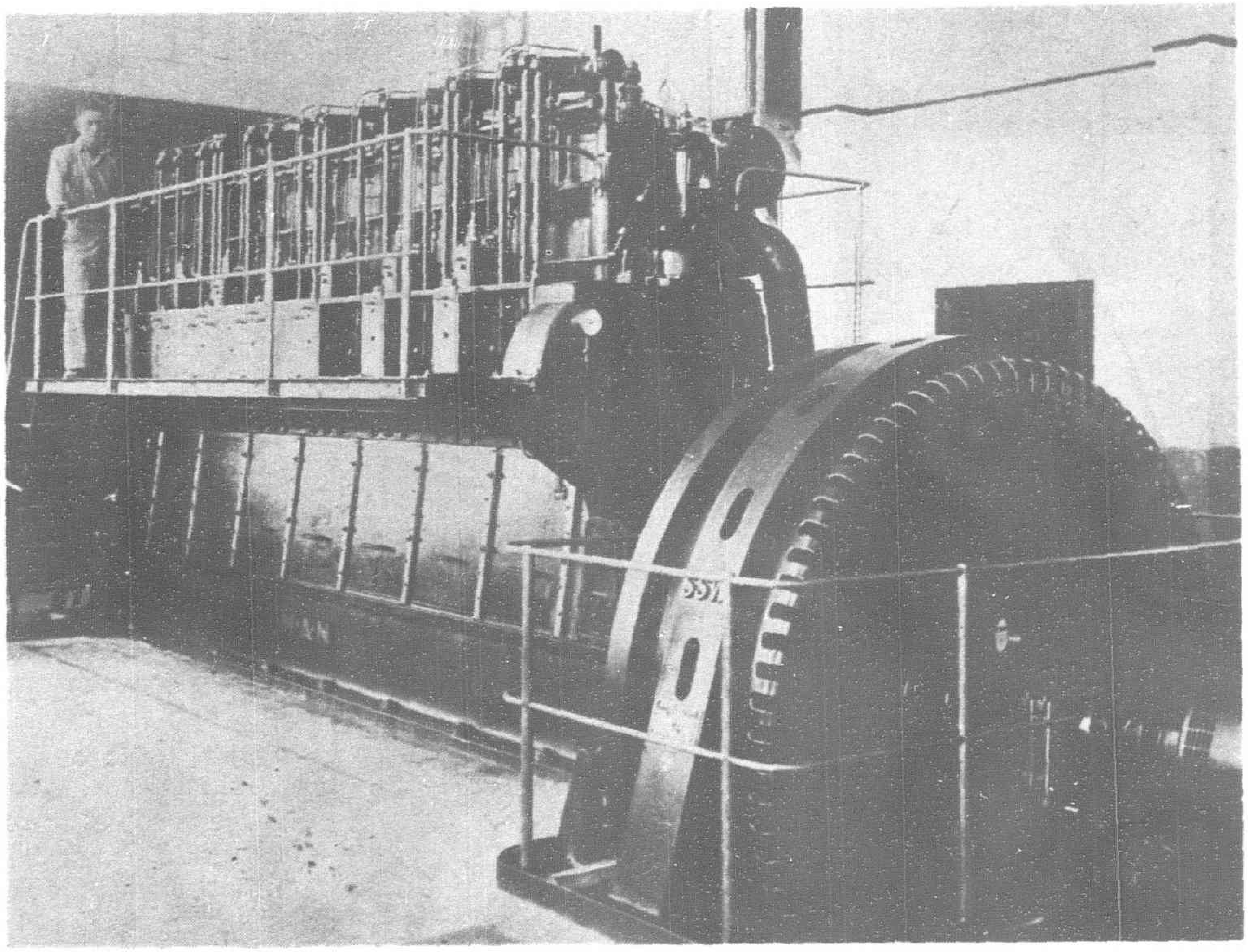
(1) *Tie rods* of high grade steel are installed during erection of engines with initial stress. They reach from top of cylinders down to the cross girders of the crankcase. They take up all stresses resulting from compression and combustion, so that the casting of the engine is thus relieved, from all stresses.

(2) *Large openings in the crankcase* enable the attendants to inspect the running gear easily.

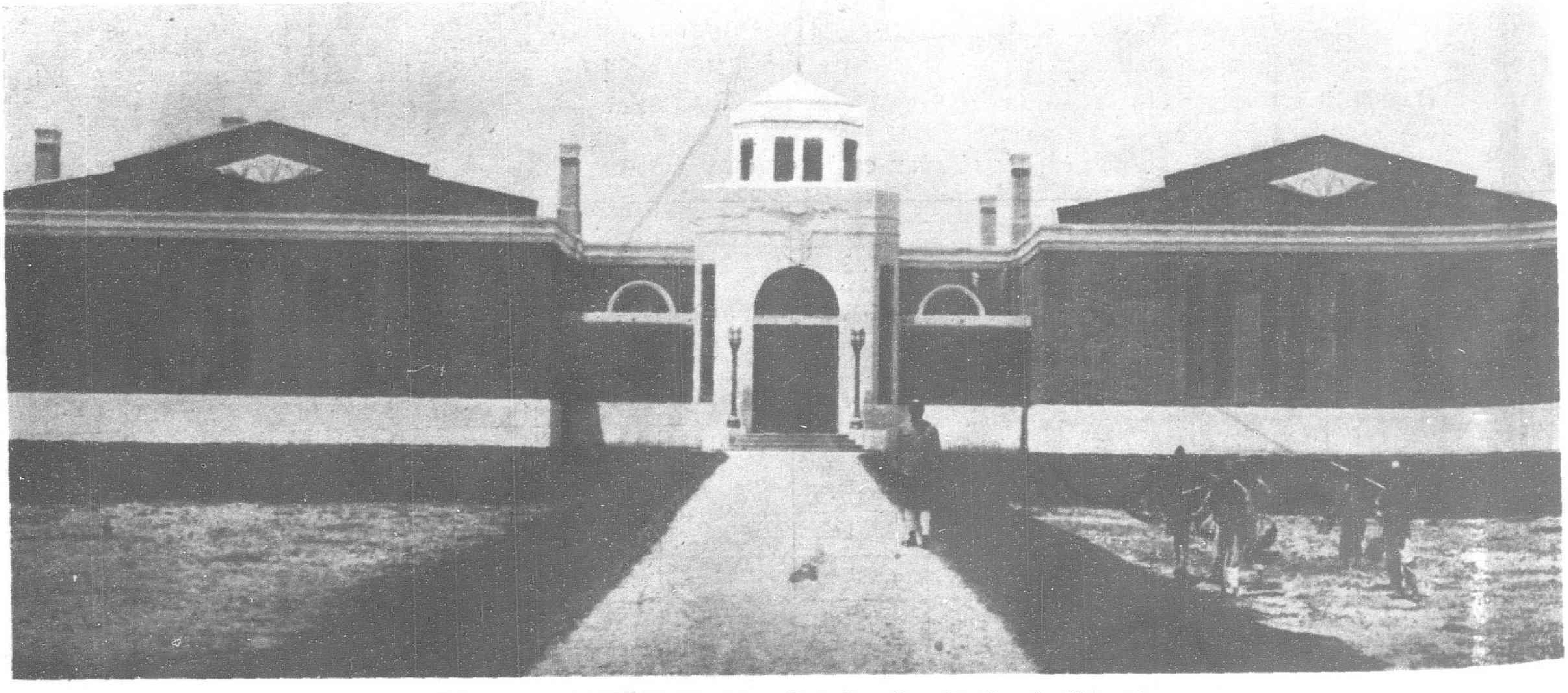
(3) The under 1./ mentioned tie-rods make for *rigidity* and *stiffness*, at the same time allowing a certain *saving in weight* of engine.

(4) Fuel pumps are not housed together in one casing, but *every cylinder has its individual fuel pump* built directly adjacent to it.

Modern safety devices, which make for ease of operation and dependability. The aerial is carried by two steel masts, each of 120 m. height. The distance of the two masts is about 250 m. An interesting factor of the plant is, that the Broadcasting Station may, by the addition of some very simple equipment, also be used as wireless sender. The entire plant is housed in three separate buildings, of which one contains the Power Plant. The whole equipment is of the most modern and up-to-date design.



Power plant of the Nanking Broadcasting Station



Structure in which Nanking Broadcasting Station is Housed

The New High Level Road to the Kelani Valley in Ceylon*

By J. M. ADAM, B.A., B.A.I., A.M.Inst.C.E., District Engineer, P.W.D.

THE New High Level Road to the Kelani Valley in Ceylon 21¼ miles in length, has been traced and designed to provide a modern line of communication above ordinary high flood level and therefore open to traffic at all times of the year, connecting Colombo with the Kelani Valley and the main road system beyond. The road takes off from Havelock Road opposite the Spinning and Weaving Mills in a south-easterly direction to the New Municipal Bridge over the Dehiwela canal at Kirillapone, and joins the Colombo-Avisawella road at the turnoff to the Labugama Waterworks near the 19½ mile post.

The original proposal included the construction of a new bridge over the Wellawatta Canal at the Spinning and Weaving Mills, but, owing to financial depression, this work cannot be undertaken at present.

The portion of the road between the take off and the Kirillapone bridge over the Dehiwela Canal has not been put in hand yet but the land required for the construction has been acquired and the advisability of undertaking this as a relief work for the unemployed is under consideration.

The other portions of the road detailed as following have been completed.

From Kirillapone Bridge the trace more or less follows the Kelani Valley Railway through Nugegoda and Nawinna village areas till it joins the old Cotta-Kottawa minor road alongside which it runs for some three miles. It was originally intended to take over and improve this minor road and absorb it into the new road but opposition from villagers to the acquisition and demolition of the buildings which would have been necessary for the required reservation was so strong, and the cost of acquisition was likely to prove so expensive, that it was decided to abandon the old road and cut an entirely new trace a short distance from it. That this decision was sound has been amply proved by results.

From Kottawa, where the new road leaves the minor road, the trace runs through numerous paddy fields to a point about half a mile from the village of Homagama where it crosses an existing minor road. This minor road has been taken over and improved and forms an approach both to the Railway Station and Rest House.

From Homagama Junction the road runs on a gently rising gradient for one and a half miles to cross the Kelani Valley Railway by an overhead bridge. The site chosen for this bridge is one where the railway runs in a deep double cutting through hard cabook or laterite necessitating very little expenditure on abutments although great care had to be taken in laying out the approaches which form a large "S" in plan.

From Homagama Railway Bridge the trace runs along somewhat uneven ground to Panaluwa Ela Bridge, crossing the old Cotta Padukka minor road near the 17th mile post. The Panaluwa Ela (or stream) is small in itself but, being affected by floods from the back-waters of the Kelani, it has been necessary to provide a bridge with a span of 30 feet.

From Colombo to Panaluwa Ela Bridge the road runs over undulating country and across paddy fields subject to only minor local flood conditions; but from this bridge to the end of the road difficult flood conditions, due to the rising of the Kelani Ganga, have had to be considered and dealt with.

About one mile beyond the Panaluwa Ela the Pusweli Oya is crossed by a bridge having a span of 120 feet and a roadway of 18-ft. This *oya* (large stream) drains a considerable area of open flat land to the south of the road and, during flood time, rises to a considerable height, and discharges a large volume of water. The Bridge is situated three-quarters of the way across the valley which is approximately 2,000-ft. wide and is approached by embankments 20-ft. high.

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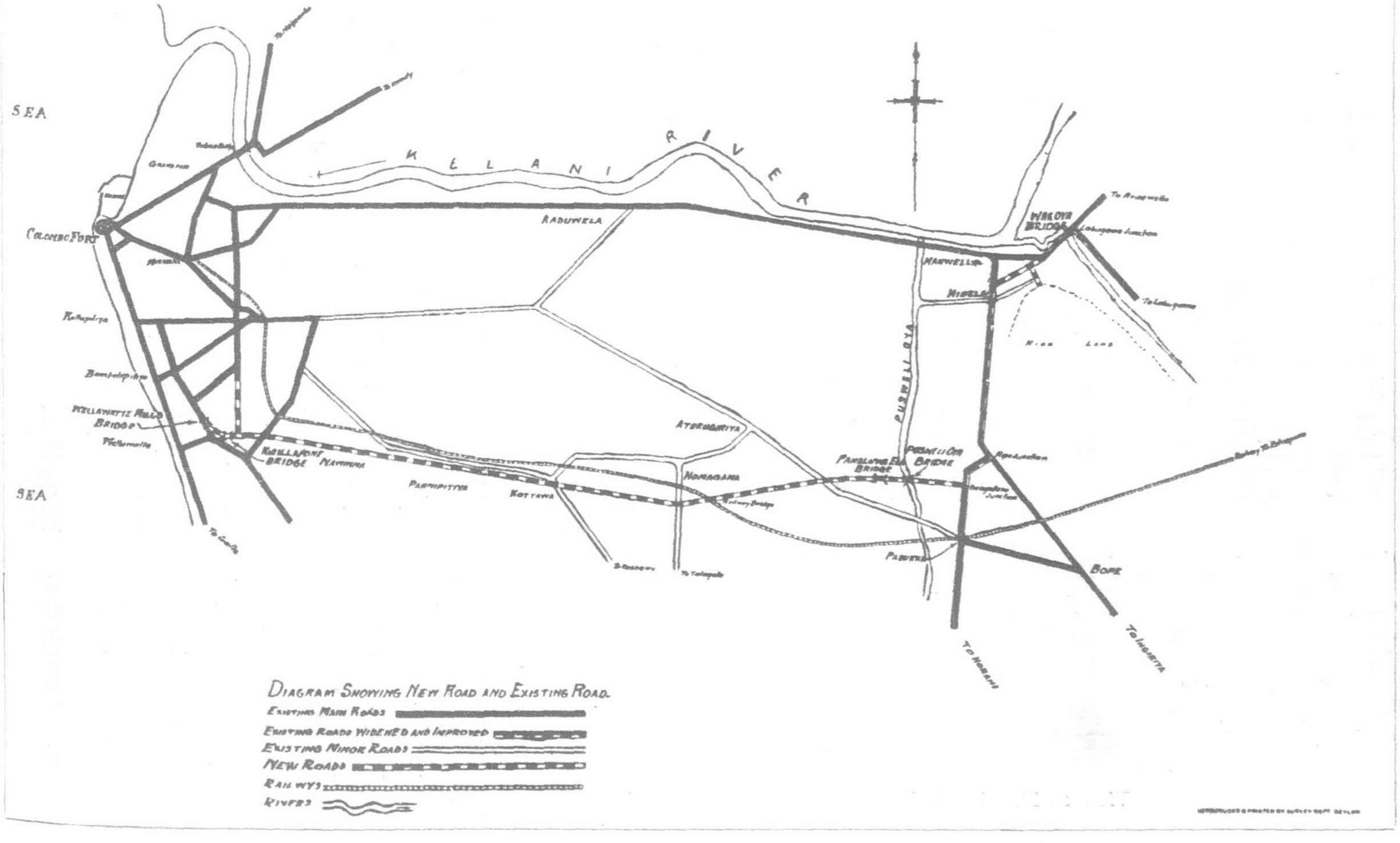
* As reported to *The Engineering Association of Ceylon*, Transactions for 1932.

NEW HIGH LEVEL ROAD TO THE KELANI VALLEY



Three-quarters of a mile beyond the Pusweli Oya Bridge the road joins the existing Public Works Department main road from Hanwella to Padukka at Galagedera approximately one mile from Padukka. A quarter of a mile further on the road meets the Ingiriya-Hanwella road at Mipé Junction. The junctions at Galagedera and Mipé have been made triangular in form so that traffic, converging on the junctions, can disperse itself along either of the three lines of road which are separated by a raised grass plot on the center of which a signpost has been planted.

From Mipé to Pathgama, a village half a mile from Hanwella, the existing P.W.D. road was raised in places and widened throughout its length.

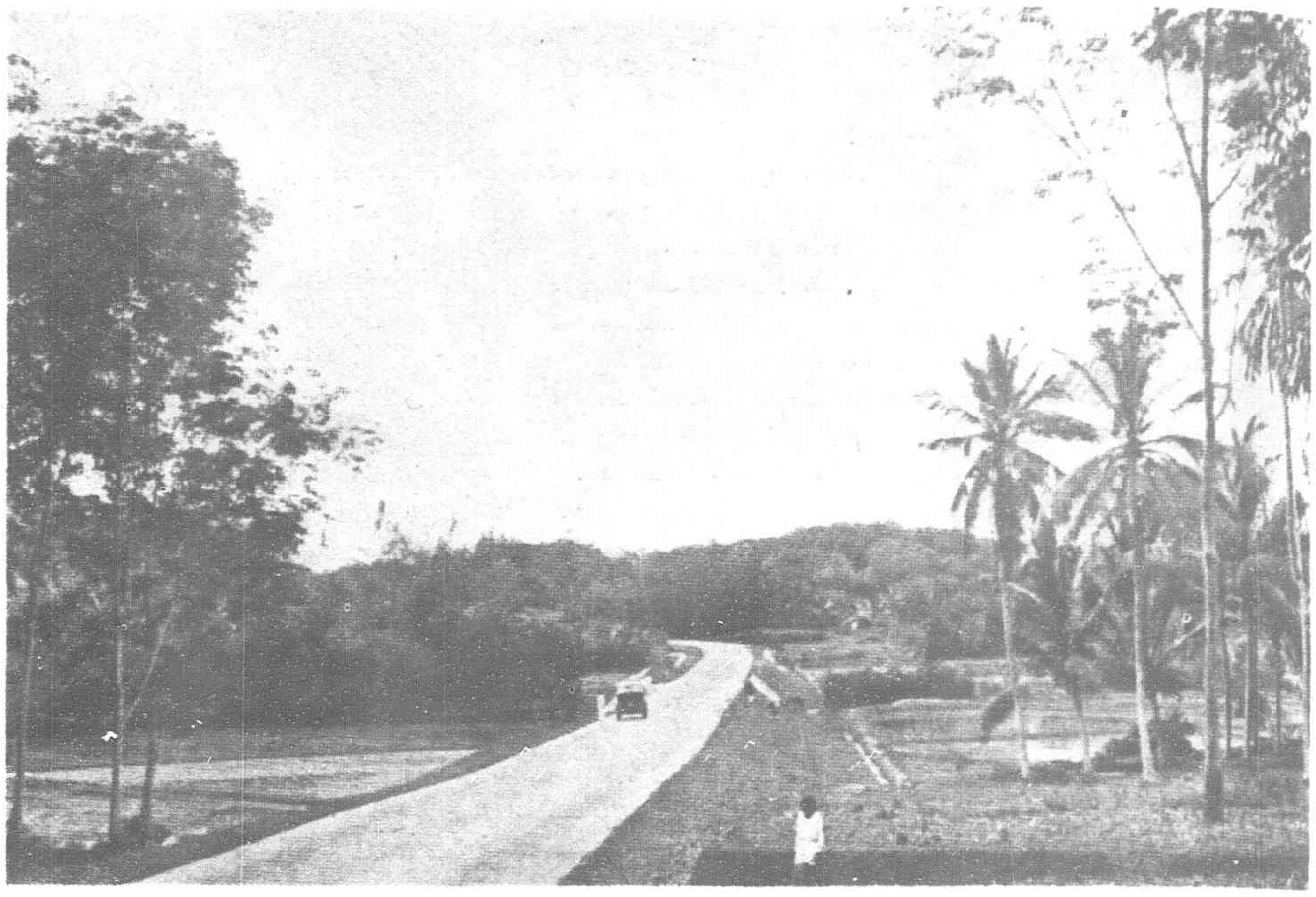
At Pathgama the road turns north-eastwards through a deviation on high ground which was necessary to avoid the flooded sections of the old Kelani Valley road between the 18th and 19th mile posts, to join the old Kelani Valley road at its junction with the road to Labugama Reservoir close by the 19½ mile post. Close to the turnoff to Hanwella a new road has been made running eastwards connecting Niripola and Diddeniya villages to the High Level Road. This new road is carried on a high embankment which serves the purpose of preventing flood water from the Wak Oya from flowing southwards to the new road where it crosses the same valley lower down, thus saving the expenditure which would otherwise have been necessary for the construction of a large bridge and preventing the frequent flooding of a large area of valuable land.

The Colombo Water Mains are crossed at the junction of the new road with the old Avisawella road and, in order to take the load of the new bank off these and make the pipe line freely accessible, a bridge has been built having a direct span of 17 feet and a span of 30 feet on the skew. This bridge has been blocked up so as to prevent water passing under it and over the pipes in flood time.

The old Avisawella road from the 19th mile post to the Wak Oya Bridge at the 19½ mile post is low lying and has always been one of the first sections of the road to be affected by floods. To deal with this the new road has been constructed alongside it on banking from 10 to 16 feet above the old road level.

The Wak Oya—the stream which, in its higher reaches, fills Labugama Reservoir and supplies Colombo with water—is crossed by an 80 feet span bridge having a roadway 18 feet wide and is a striking contrast to the old bridge alongside it as will be seen from the accompanying photograph.

View on New Road showing Width



View on New Road near 13½ Mile Post

Beyond this bridge the road to Labugama turns off eastwards and the approaches to this have been regraded and improved.

The new construction work ends opposite the entrance to Kaluaggala Roman Catholic Church, the old road having been regraded and improved by eliminating a dangerous blind corner between that point and the bridge.

Although the road has been designed to be above flood level, the floods to which this applies are normal ones but exceptional floods, such as occurred in 1913, will top the road. The raising of the levels to provide against maximum floods would have been a waste of money as it would have meant that the new road would have been isolated, as other sections, in the direction of Avisawella, have not been raised. It is noteworthy however that even in the exceptional floods which occurred in May, 1930, the depth of water at any point on the new road did not exceed one foot.

Reasons for Adopting the Trace

The old Avisawella road, which runs through Ambatale, Kaduwela and Hanwella close to the river, is subject to flooding twice a year for periods of considerable duration and this flooding caused serious interruption to traffic where the floods were worst, *i.e.* between Colombo and the 19½ mile post. The increase in motor car and motor lorry traffic in the years following the war accentuated the inconvenience caused by these floods and necessitated the investigation of remedial measures to deal with them. The first suggestion which, naturally, required investigation was the raising and improving of the existing road but, as this appeared likely to be very expensive and unsatisfactory, it was soon given up and investigation diverted to providing some less costly solution of the problem. The principal reasons which governed this decision were that the valley of a river, such as the Kelani, is the most unsuitable line for a road which is required to be above flood level; that the acquisition of land and buildings to provide for the required reservation width would be expensive and would necessitate the dehousing of roughly one-third of the village population along the existing road, who would have no suitable land on which to rebuild; that heavy bridging would be necessary to deal with a practically unknown volume of water flowing between the Kelani River and the lowland to the South across the existing road in flood time; and last, but not least, that traffic would continue to discharge into the congested Dematagoda and Maradana areas of Colombo necessitating heavy costs in improving roads inside Municipal limits.

The idea of improving the old Avisawella road having been abandoned the possibility of utilizing some of the other existing roads was next considered and the only possibility in this direction appeared to be the P.W.D. road from Hanwella to Padukka and minor road from Padukka to Cotta. Whilst very little bridging would have been required to deal with floods on these roads the objections to their use were, in general, the same as in the case of the Kelani Valley road, *i.e.* it would be necessary to dehouse a considerable number of villagers and traffic would continue to discharge into the congested areas of Colombo.

It was finally decided that the best method of dealing with the problem was the construction of a completely new road for most of the required length; and it may be stated incidentally here that this will invariably be found to be the most economical method of dealing with road construction under similar conditions.

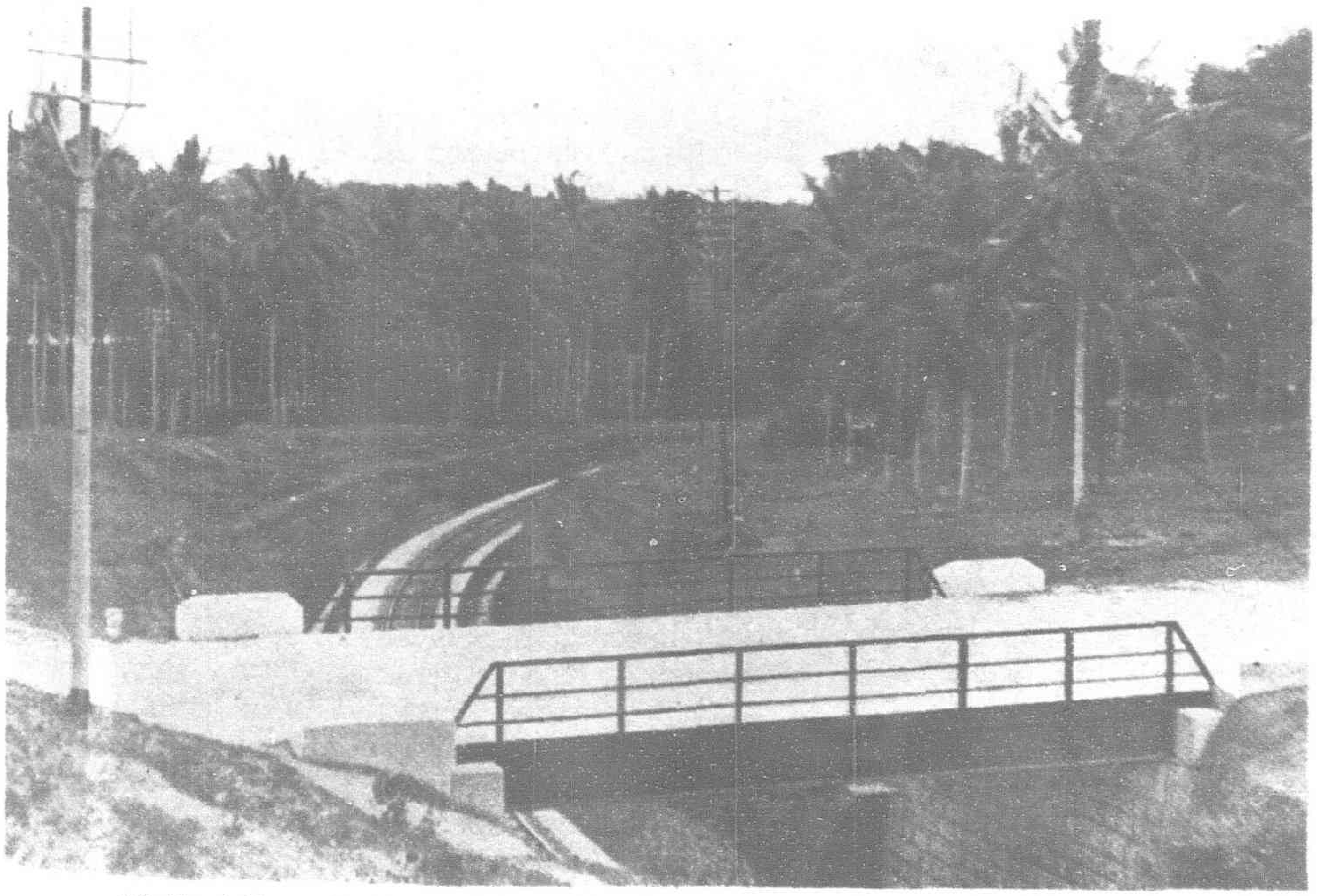
The trace adopted has the advantage of reducing the cost of acquisition and the number of villagers to be dehoused to a minimum; of providing additional frontage for new buildings; and of discharging traffic into an area of Colombo where wide roads are available for distributing traffic on its arrival and no expensive program of road widening in the city is necessary.

Specification

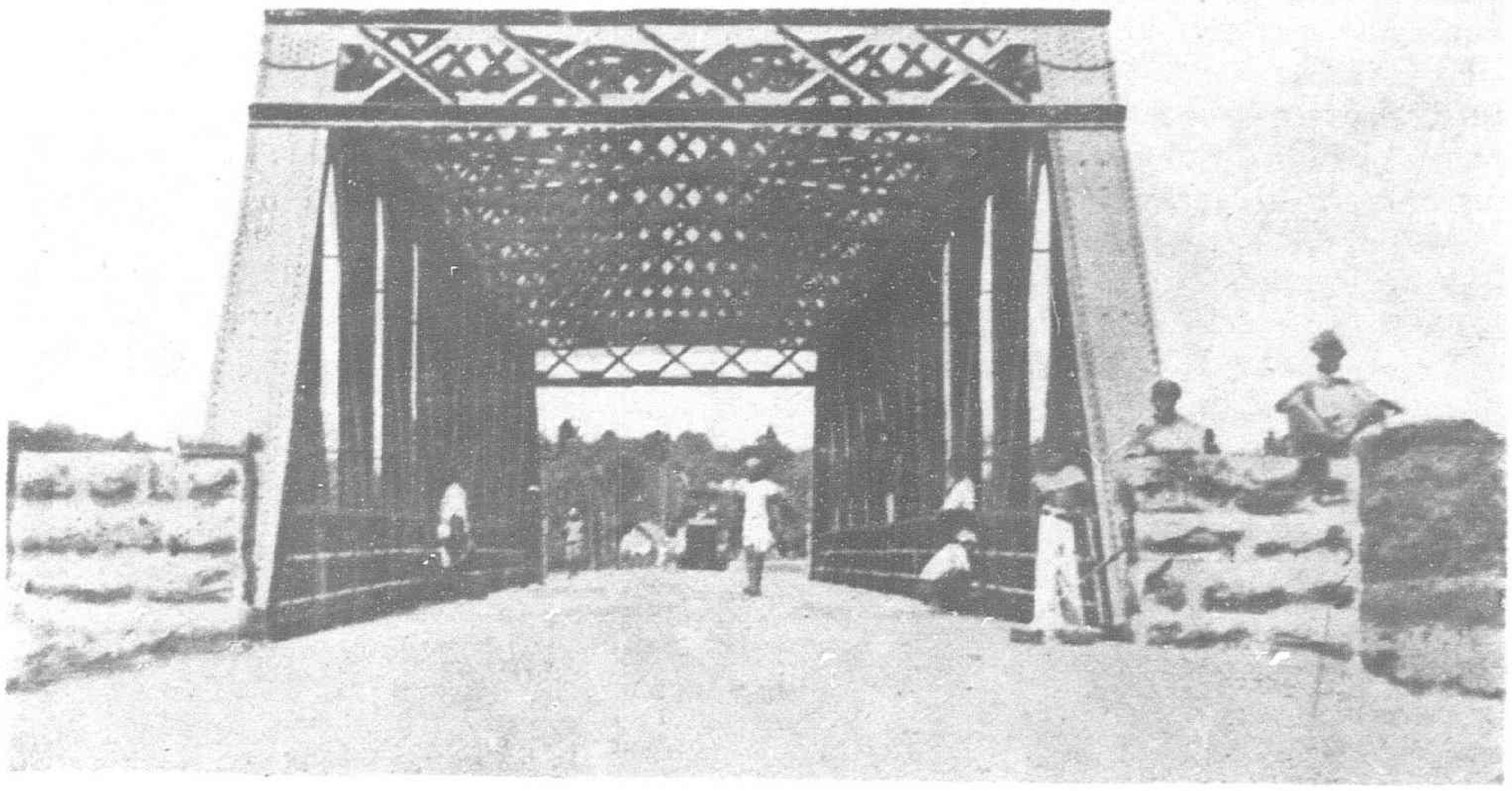
The plans and estimates provided originally for a road having a metalled width of 16 feet (except inside Municipal limits where the width was to be 40 feet) at a cost of Rs. 2,218,000 but it was decided later to increase the metalled width to 20 feet to conform to the British Ministry of Transport specification for main roads and the estimate was increased to Rs. 2,650,000. This included certain additional works not provided for in the original estimate. It may be stated here that the additional 25 per cent width of traffic way was obtained at an increased cost of only 11 per cent over the cost of the narrower traffic way originally intended.

The specification which was finally adopted was as follows:—

Metalled width	20 feet
Width on Banks and between Side Drains	26 ,,
Stone Foundations, 9-in. thick	22 ,,
Surface	Bitumen Paint
Width between Parapet of Culverts	26 feet
Width of Roadway of small Bridges	24 ,,
Width of Roadway of large Bridges	18 ,,
Land Reservation	66 ,,
Ruling Gradient	1-in. 30 ,,
Minimum Radius of Curves	150 ,,



30 Feet Span Bridge, 24 Feet Roadway, over Kelani Valley Railway



Pusweli Oya Bridge showing Roadway

Connecting Roads

It has been stated that no internal improvements would be required in Colombo and this is, strictly speaking, accurate: but in addition to the main line provision was made for one large connecting road, namely Baseline Road South Connection estimated to cost Rs. 285,000. Unfortunately the financial condition of the Island has not been such as to allow of this proposal being carried out and a very useful connection has had to be given up and allowed to lapse.

This proposal originated with Sir Cecil Clementi, Colonial Secretary, when administrating the Government and consisted of extending Baseline Road directly south so as to join the new road at Kirillapone. Its object was to provide direct access from the new road to the Borella area of Colombo and divide up traffic before it entered Colombo. It also had in view the opening up of a large block of excellent building land lying between Kirillapone and Narahenpitiya and developing a new suburb close to Colombo and with easy access to the Fort.

Tracing

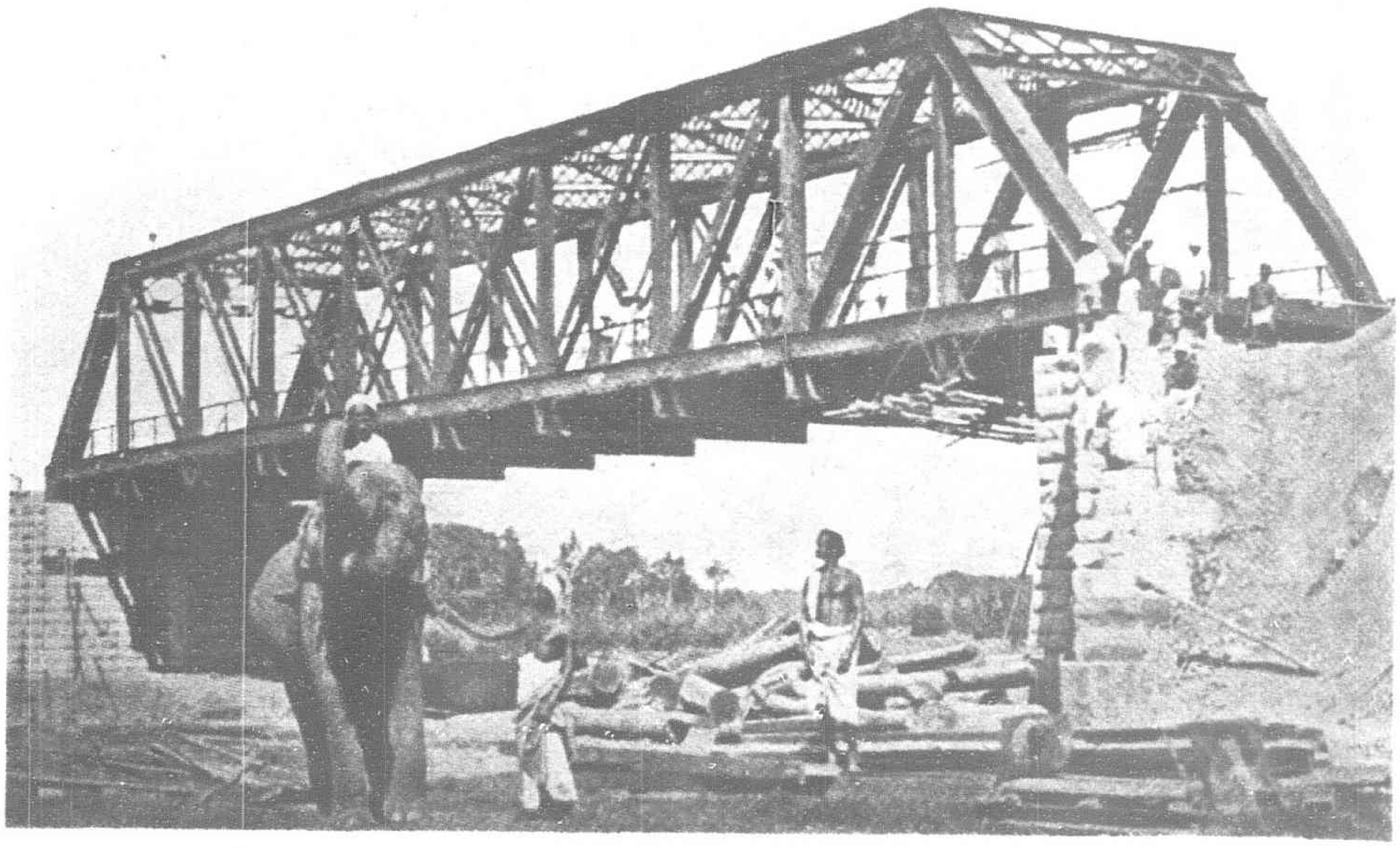
In laying down the trace reference was made to the very excellent contour maps prepared by the Survey Department of Ceylon and too much emphasis cannot be laid on the assistance which these maps gave in locating the best line to be adopted. These maps made tracing easy and it was possible to select the best line to be adopted and proceed along it with practically no preliminary investigation.

The main objects kept in view in preparing the original survey were (*a*) Alignment and the necessity for keeping curves as flat as possible consistent with reasonable economy in earthwork.

(*b*) That, whilst the quantity of earthwork should be reduced to a minimum, such reduction should not be a ruling factor. It was realized that reduction of earthwork quantities (and consequently costs) is uneconomical if, by so doing, the length of road is increased and the cost of other more expensive work expanded.

(*c*) That special attention should be paid to the provision of suitable building frontages on both sides of the road especially in the neighborhood of Colombo where the opening out of a main thoroughfare was likely to lead to the development of a new suburban area and the construction of new buildings. That this assumption was justified is proved by the rapid development on the first five miles of the new road, where it passes through Kirillapone, Nugegoda and Nawinna villages, and where over 100 substantial buildings have been erected since the road was opened to traffic some three years ago. It is only to be regretted that this development is being allowed to go on almost uncontrolled and that advantage has not been taken of an almost unique opportunity for town planning and the scientific laying out of feeder roads to assist development which the improved communications provided.

The writer has been asked, in preparing this paper, to include in it certain information which was embodied in a report submitted to the Director of Public Works when the work was completed. This information covered various subjects such as calculation of quantities, methods of carrying out work, etc., and was intended mainly for the information of officers of the Public Works Department engaged on similar undertakings in the low country. Some of it is elementary but most of it has been included in this paper in the hope that it may prove useful to members and serve as a reminder of factors that might otherwise be overlooked.



Pusweli Oya Bridge 120 Feet Span

Estimates

It is usual in Ceylon to divide estimates up mile by mile but this method was not adopted in the present case. In place of it the whole work was divided up into sections of varying lengths and based mainly on physical features such as a junction with, or crossing of, a main road or the railway. This method was found to be satisfactory as it made it possible to let out contracts of varying lengths to suit contractors' capabilities and capital and to divide supervision within more definite limits. It also meant that earthwork for filling was always obtained from the same section or division of the work from which it was cut and thus facilitated both measurements and accounting.

The estimate was divided into four main subdivisions which covered :—

(*a*) Construction works such as earthwork, stonework, culverts, etc.
(*b*) Large bridges and special culverts.
(*c*) General Items such as lines, acquisition, plant and surveys and
(*d*) Supervision and Contingencies.

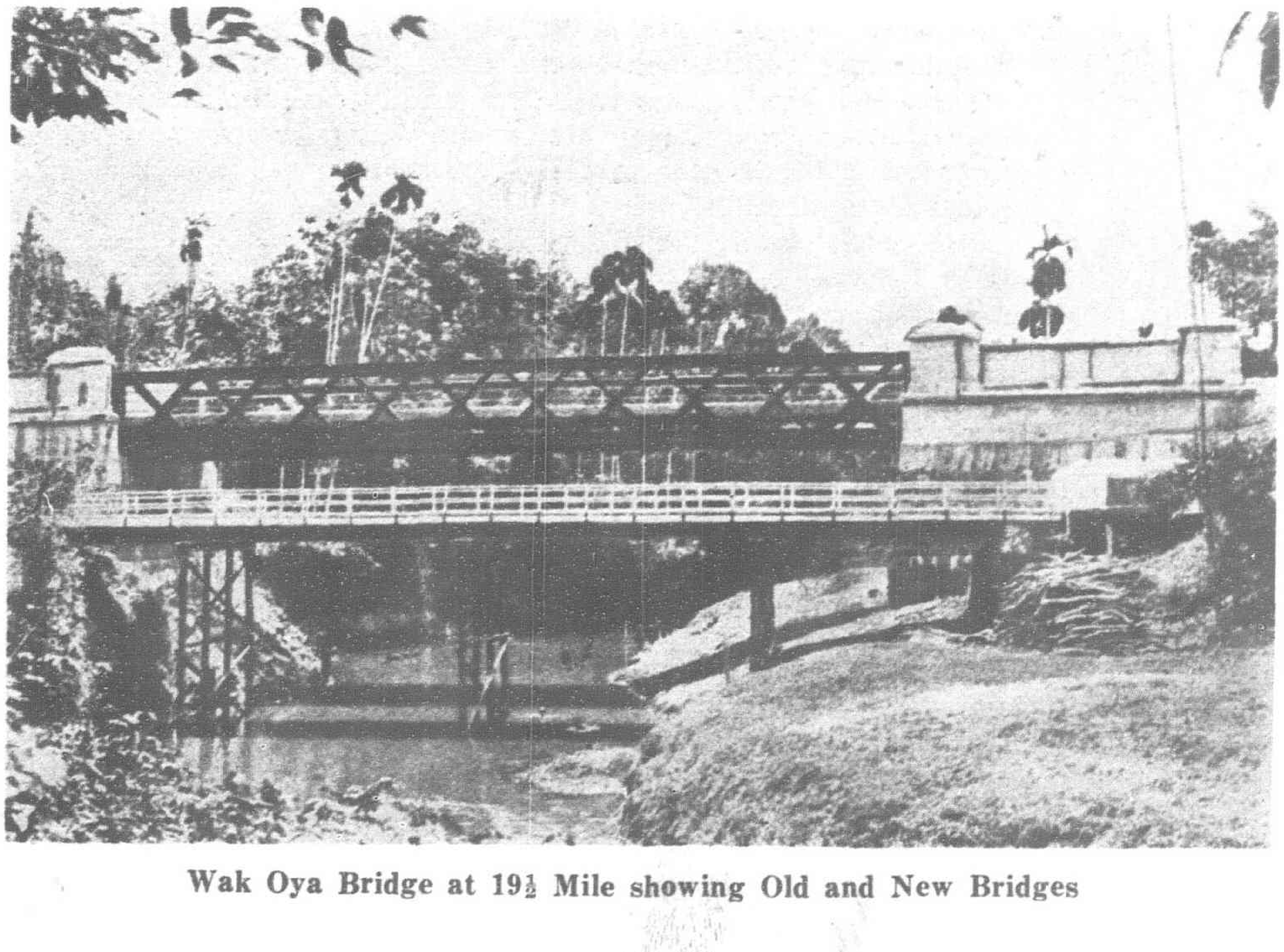
Earthwork

The country round about Colombo consists, geologically, almost entirely of good cabook or laterite with occasional large outcrops of rock. A certain amount of brittle white disintegrated stone occurs in places but the total quantity is practically negligible. This cabook or laterite is easily worked especially in wet weather; has an angle of repose almost vertical and consolidates into a hard mass when tipped into banks and allowed to settle. It forms almost the ideal material for road construction work.

A considerable proportion of the total length of road crosses paddy fields and in calculating the quantities of spoil required for the banks an allowance of from 15 per cent to 20 per cent was made for penetration. This was found, in practice, to be quite inadequate especially where banks from 4 to 5 feet high predominated, the excess over the calculated quantities amounting in some cases to as much as 60 per cent. This is reasonable when it is realized that there is an initial penetration in paddy fields of from one to two feet according to conditions at the time spoil is tipped and the nature of the paddy field soil and, as this penetration is spread over the base of the bank where it is widest, it forms a high percentage of the total volume of filling required. Investigations were carried out to see if some more reliable method of estimating could not be evolved, and, whilst there were considerable differences between extremes, it was found that a rough and ready method of fair accuracy would be to allow for an initial penetration of one foot six inches plus one inch per foot height of bank. This allowance can be shown on the cross sections as penetration in the usual way.

It was originally intended to roll all banks before foundations were laid but this was found to be impracticable mainly due to the fact that rollers tended to sink very deep into the filling which had been tipped even one year before and in consequence suffered badly and delayed work.

In place of this new banks were constructed to designed level for the finished road plus a settlement allowance and were allowed to stand for a year. A track was then cut to the designed width of the foundation and six inches deep and foundations laid and rolled. When the road was finally finished it was usually found that the verges stood up some six inches above the metalled surface and had to be cut down to conform to the designed section. As the earthwork contracts had long since been closed it was not possible to make the cutting down of these edges part of the contract and additional expense had to be incurred for which no provision had been made in estimating and quantities were, in consequence, exceeded. The average quantity for this worked out at 3 cubic feet per foot run of bank and it is advisable that provision should be made for this in the earthwork quantities in future estimates. An attempt was made to avoid this additional cost by leaving the edges lower to begin with and by laying the foundation stone on top of the bank



Wak Oya Bridge at 19½ Mile showing Old and New Bridges without cutting a trench for it but this was not found to be satisfactory as the foundations tended to "spread" badly when rolled due to lack of lateral support.

Provision in earthwork quantities, which are often apt to be overlooked, are for metal depots, scour due to rain or to flood lap on the toes of new banks; provisions for halting places for buses; and for widening out junctions. No specific data is available for estimating these as they vary considerably according to circumstances but in the case of metal depots it may be stated that the most satisfactory and economical position is usually at the junction of cuttings and fillings if no level spots are available elsewhere.

Light railway track was used throughout the work and is almost indispensable where large quantities of materials have to be handled and no made roads exist. Trollies of 18 cubic feet capacity and rails of 16 lb. per lineal yard were used and proved satisfactory.

In constructing banks the method of working was to run out a narrow bank say 5 feet wide well ahead of the general work and then to tip in on each side. This made it possible to set the required level ahead of the main work and also gave two tipping faces. It was not often necessary to use both these tipping faces unless there was some urgency but they were always available if necessary. Rails were moved across from the center as work of widening progressed until the full width was obtained.

Practically the whole of the earthwork was completed during the boom years when prices were high and labor expensive so that these costs are of very little use under present conditions. The average worked out at Rs. 2.40 per cube (65 cents per cubic yard) and can be divided up into two distinct sections namely, where flood banks were being constructed with long lead, and in ordinary cut and fill sections where the lead was much shorter. In the former the cost worked out at Rs. 2.64 per cube (71 cents per cubic yard) where the lead was between 2,000 and 2,500 feet average; and in the latter at Rs. 2.14 per cube (58 cents per cubic yard) where the lead averaged 600 to 700 feet. These rates included all charges such as laying and maintaining trolley lines and trimming slopes.

Foundations

The specification provided for nine inch sledged stone foundations laid on edge throughout with no provision for smaller stone for sealing before metal was laid. Quantities of sledged stone required were based on this figure plus 10 per cent forvoids in piling or 0.83 cubes per square of paving. Allowance was also made for opening out junctions and road crossings.

The quantities actually required worked out at 0.75 cubes per square (0.25 cubic yard per yard sup.) but this figure is apt to be misleading as the depth of paving was reduced to six inches in double cuttings where hard formation was available. The actual quantity used per square varied considerably due to conditions under which it was laid and rolled but a fair basis for estimation would be :—

	cubes per square	*cubic yd. per yard sup.*
In double cutting with good formation where only six inches depth is required	0.55	0.18
For single cutting in side long ground with full nine inches depth	0.80	0.27
For banks with average well settled fillings	0.90	0.30
For soft banks and unstable ground ..	1.00	0.35

Special provision should be made where circumstances make it possible that extra stone will be required due to soft ground.

The type of foundations provided for above are "Open," *i.e.* the smaller voids are not filled up but left to form an intimate bond with the surface metal. This was found to be expensive in its consumption of metal and about 0.15 cubes per square (0.05 cubic yard per yard sup.) of four inches or 3½ inches metal should be provided to be spread loosely over the foundations before they are rolled and to act as a seal.

The method of laying was based on four operations namely the larger stones were laid on the prepared formation with flats down and tips up. It was impressed on the laborers that these stones must be laid vertical and not leaning up against their neighbors and that the longest axis should be parallel to the center line of the road. Insistence on these three cardinal points made it possible to get a more intimate locking of stones and facilitated the next operation. After the large stones had been laid to form a very open surface, large wedging stones were driven in with 4 lb. hammers to tighten up the main bedding stones. Smaller wedging stones were then driven in to increase the wedging effect and finally all projecting points were knocked off with a 1 lb. hammer on a long handle and allowed to lie and be crushed in when rolled. The quantity of chippings, however, did not prove to be sufficient for a proper seal and metal had to be used as well.

It is for this reason that the provision of a small supply of four inches or 3½ inches stone is recommended.

When the foundations had been laid a 10 ton roller was passed over them till they conformed to the general designed outline of the road. As a rule there was fairly even settlement and little difficulty was experienced in obtaining the correct shape approximately except when rolling was done in wet weather. Small hollows which occurred during rolling, if they did not exceed three inches to four inches, were made up with metal but where they exceeded that figure or where high spots occurred which could not be rolled down, the paving was lifted and reset. The necessity for lifting the paving did not amount to more than 5 per cent of the total length except on a section of new banking which was rolled in wet weather and where flood levels had to be considered. This section, over 1,000 feet long, sank between one and two feet when rolled and had to be relaid.

When the paving had been thoroughly rolled and appeared to have assumed its correct shape a thin layer of metal usually 0.10 cubes per square (0.03 cubic yard per yard sup.) was spread and rolled in to seal the foundations and, when fairly consolidated, was slightly roughened up to provide a bond with surface metal and the final layer of surface metal was laid. This system of operations proved successful although the estimate did not provide for sufficient metal to give a full final layer four inches thick.

The average cost of sledged stone piled in the quarry worked out at Rs. 6 per cube (Rs. 1.62 per cubic yard) and piled on the road at Rs. 10.95 per cube (Rs. 2.95 per cubic yard) the average distance of transport being about one and a half miles over unmade roads. Practically all this work was done in 1927 to 1929 when rates were high and the costs are not a fair guide under normal conditions.

The average cost of laying came to Rs. 3.35 per square (90 cents per yard sup.) which included all charges for rolling. It was possible latterly to reduce this to Rs. 2.75 per square (75 cents per yard sup.) of which Rs. 2 represented cost of laying and cents 75 cost of rolling and this would probably be a fair basis for estimating under normal conditions.

Metal

The specification provided for a thickness of five inches of two inches metal which, it was anticipated, would consolidate to a finished depth of four inches and the quantities provided for in the estimates were based on this with no allowance for voids in piling or for granulating. This amounted to 0.42 cubes per square (0.11 cubic yard per yard sup.). This quantity was quite insufficient to provide four inches finished depth due to the fact that the foundations absorbed a considerable portion of it and the finished depth was seldom more than 2½ inches.

A certain amount of this metal was passed through a granulator which produced approximately 35 per cent stone one inch and over and 65 per cent under one inch. The proportions varied considerably according to the condition of the jaws and nature of the stone. Stone under one inch was reserved for use as a filler over the bitumen surfacing but stone over one inch was used as a blinder when two inches metal had been partly rolled and proved useful in closing up spaces on the surface.

Metal was laid in two stages. After foundations had been rolled and formed roughly to shape, a thin layer of two inches metal was laid and gradually rolled to correct shape. It was then slightly loosened with a pickaxe and the final surface layer laid and rolled. This final layer should normally be four inches thick but, as supplies of metal were insufficient, it seldom exceeded 2½ inches. Some few weeks after metal spreading was finished the bitumen surfacing coat was laid and blinded but this method is not recommended for future work as it was found that the surfacing tended to break up due to the slight internal movement which is almost inevitable in new road work. A much more satisfactory method to adopt is to lay the foundations and first metal layer and allow traffic to use the road for so long as it remains in reasonable order. When the surface has reached a state of deterioration which makes it uncomfortable for traffic to use it the surface should be roughly picked up and the final metal layer laid down, consolidated, and surfaced. This method was adopted latterly and has led to a more satisfactory and permanent surface.

If this method is adopted and if provision is made for the small quantity of four inches or 3½ inches stone recommended the following quantities of metal will be required for the various construction work.

	cubes per square	*cubic yd. per yard sup.*
For first layer metalling	0.15	0.05
For final layer metalling	0.35	0.12
For granulating for surfacing . ..	0.05	0.02
Total	0.55	0.19

This should allow for a full finished depth of four inches metal.

The cost of metal supplied in the quarries averaged Rs. 9 per cube (Rs. 2.43 per cubic yard); and on the road, with 1½ miles transport over unmade roads, Rs. 14 per cube (Rs. 3.78 per cubic yard).

The cost of spreading worked out at Rs. 4.07 per cube (Rs. 1.10 per cubic yard) including all charges for rolling, etc. The rate, latterly, fell as low as Rs. 3.40 per cube due to reduction in labor charges and this should prove to be a fair average figure for future work.

Surfacing

The road has been opened for a comparatively short time and it is too soon to say definitely which of the types of surfacing experimented with will prove the most satisfactory. It will be difficult to decide on this in any case as they were laid under varying conditions.

The types tried out were :—

(*a*) Ordinary hot run bitumen paint.
(*b*) Emulsion paint.
(*c*) Hot bitumen grout and emulsion seal.
(*d*) Emulsion grout and hot run bitumen seal.
(*e*) Emulsion first coat paint and hot run bitumen seal.
(*f*) A small quantity of Road Board tar.

Nos. (*b*), (*c*) and (*f*) definitely proved to be unsatisfactory and did not last.

No. (*a*) proved satisfactory but there was a tendency for it to lack adhesion and roll up under traffic.

As far as can be seen at present No. (*d*) seems likely to prove the most satisfactory and the method of laying may be of interest.

The road was first given a rough brushing with bass brooms to remove large grit and cattle droppings. A heavy jet of water was then played on the road from a water cart. As the water cart moved slowly forward six laborers followed it in echelon brushing as hard as possible until the road was scrubbed clean. The road at this point was thoroughly soaked and wet and whilst in this condition from 3½ to 4 gallons of 57 per cent emulsion were sprayed on per square (from .85 to 1 gallon per yard sup.). As soon as the emulsion had broken and become black a thick layer of half inch chips was spread and the surface rolled with an 8 ton roller at once. When the roller had passed over twice or three times a layer of quarry or granulator dust was laid and again rolled. The road was then opened to traffic for one or two months, after which it was thoroughly brushed and cleaned and 1½ to 2 gallons hot run bitumen was spread with squeegees and blinded with either quarter inch chips or coarse sand. This method proved (apparently) to be the most satisfactory as it appeared to give better adhesion to the underlying stone than straight run hot mix surfacing.

All the experiments have been stultified, somewhat, by the fact that internal movement has tended to make the surfacing break much sooner than it should and it is recommended that a longer period be allowed for this internal movement to cease before surfacing is laid.

As the method of treatment varied considerably it is not possible to give an average rate for surfacing carried out on the whole job but the type mentioned above worked out at approximately Rs. 4 per square (Rs. 1.08 per yard sup.) which included the cost of rolling and granulating metal for filling.

Culverts

Two types of culverts were used throughout the work except in a few isolated cases namely, precast concrete pipes and masonry culverts with reinforced concrete decking.

Concrete pipes 2 foot internal diameter were standardized, one to four lines being used as required. As the road ran for a considerable distance on high land relatively few culverts were required, the number of pipe culverts averaging about 10 per mile. About half the number were required to deal with irrigation and drainage channels in paddy fields where foundations were poor but little difficulty was found in dealing with these. The usual method adopted was to excavate to the level of the bottom of the concrete foundations and then drive in nine inches sledged stone on edge till the whole was solid, wdging stones being used to tighten up the surface. This method proved satisfactory and provided a clean bed for laying the concrete foundations. No instance of settlement or fracture occurred throughout the work. On top of this prepared bed six inches of cement concrete gauged 4: 2: 1 was laid. Where the depth between road level and the top of the pipe was less than four feet the pipes were encased in cement concrete four inches thick but where the depth below road level exceeded four feet no casing was used, the pipes being merely haunched in concrete up to springing level.

In fixing the number of pipes required, their position and level, the local land owner, as the one most concerned, was always consulted and the result has been that no complaints have been received. The ordinary villager has a very sound idea as to what is required to irrigate or drain his fields and the number of pipes required agreed fairly closely with the number provided for in the estimate. It was possible in a few cases to cut out culverts provided for in the plans by diverting water into enlarged side drains and carrying it to an adjoining outlet.

In the case of culverts carrying irrigation channels under the road it was usual to set the invert approximately three inches below the channel bed but in the case of drainage channels the invert was set nine inches below ground level.

Practically all pipes were carried out to the toe of the bank with concrete head walls at 45 degrees to the center line of the culvert dropped to conform to the slope of the bank. It was found that it was more economical to extend culverts to full length than to shorten the culverts and construct heavy head retaining walls. The adoption of wings at 45 degrees makes it possible to reduce the thickness of masonry as the wings act as buttresses to the retaining walls which in all cases were only one foot thick. These head walls were carried up to varying heights above bank outlines to see which was most effective. Latterly they were constructed only sufficiently high for the tops to be flush with the slope of the bank, nothing appearing above that line. This method has two advantages as it reduces the cost of construction by reducing the quantity of concrete in the head walls and also reduces the cost of maintenance as there are no exposed parapets to be maintained and whitewashed. By avoiding parapets close to the road, where they are used by the local population as a convenient resting place, periodic repairs are reduced to a minimum.

The main defect in standardizing pipe culverts in new construction work is the heavy cost of handling. The pipes have to be made in a central depot, transported to site and then handled in paddy fields. This handling is costly as each pipe weights approximately 600 lb. and is difficult to deal with in paddy field mud where culvert construction is being carried out ahead of filling.

These pipe culverts varied in length, the shortest being 28 feet and the longest 70 feet. The average length was about 40 feet.

The cost per lineal foot of culvert pipe laid complete worked out about Rs. 10 but varied somewhat according to distance the pipes had to be transported and the nature of the foundations. Head walls cost about Rs. 80 each including the necessary apron and drop wall.

Larger culverts were standardized at 8 feet and 10 feet span, very few of the former being constructed. These consisted of masonry abutments and wings carried down to solid—usually about 6 or 8 feet below ground level—with reinforced concrete decking and stone sett paving. The decking consisted of a 14 inches concrete slab with double reinforcement of five-eight inches rods at three inches centers and half inch shear rods at four inches centers formed into a grid. The reinforcement was spaced 8¼ inches centers giving ample strength for almost any loading. The reinforcement was carried up into the parapet walls to strengthen them and form a light longitudinal girder.

Special Culverts

A special culvert was constructed in the Hin Ela Bank at the 25th mile post. The road is carried across the Hin Ela Valley on an embankment and it was originally intended to provide an 80 feet span bridge to deal with water from the Wak Oya discharging down the valley in flood time. It was found on investigation that this flood discharge could be prevented by constructing a short bund higher up the Hin Ela Valley and at a narrow point where it joined the Wak Oya Basin. By constructing this bund an area of approximately 300 acres was isolated from floods except through the drainage culvert in the Hin Ela Bank and it was decided to provide this culvert with automatic flood gates. Had this not been done it would have been necessary to provide for a much larger culvert to allow ingress and egress of flood water and the 300 acres referred to would have continued to be subject to floods.

The culvert was eventually constructed with four openings two feet six inches wide and four feet high each opening having two gates, (an upper and a lower), the upper overlapping the lower. These gates were hung on gunmetal links and opened under a head of a few inches. This scheme has worked satisfactorily and has not only provided flood protection for 300 acres of land but resulted in a saving of Rs. 30,000 to Government and the provision of an access road over the new bund to the villages of Niripola and Diddeniya which were formerly practically isolated during the flooding of the Kelani Ganga.

The Colombo Water Mains are crossed at the junction with the old Avisawella road by a skew bridge 17 feet on the square and 30 feet on the skew. This consists of two 24 inches by 7½ inches by 90 lb. joists with cross-bearers, trough decking and sett paving. It was erected at the request of the Municipal Waterworks Engineer in order to take the extra loading due to the raising of the road off the pipe line and make it possible to obtain free access to the pipes. As the culvert or bridge is constructed in a bank which is liable to a difference in head when the Wak Oya is in flood and the Kelani Ganga is not, it has been necessary to close up the opening by a masonry wall so as to prevent the passage of water over the pipes and possibility of scour being set up.

Bridges

The number of bridges constructed is small due to the location of the trace and only four of 30 feet or over have been built.

The bridge over the Kelani Valley Railway has a span of 30 feet with roadway 24 feet wide and, as it was in hard cabook, very light abutments were necessary, foundations being carried down some four feet below rail level.

The Panaluwa Ela is crossed by a 30 feet span bridge with 24 feet by 7½ feet by 90 lb. joists carrying Dorman Long trough decking with stone sett paving. Foundations caused some trouble but were eventually bedded on cabook gravel eight feet below bed level. Concrete abutments faced in stone with wings at 45 degrees dropped to conform to the bank outline were built.

The Pusweli Oya Bridge 120 feet span is the longest erected and consists of two Warren type girders with underslung cross bearers, lattice wind bracing, Dorman Long troughing and stone sett decking. The steel work was designed in the Public Works Head Office and was fabricated and erected by the Government Factory.

The foundations consist of cement concrete octagonal cylinders founded on rock and filled with 8 : 4 : 1 cement concrete. Some difficulty was found in sinking the wells on the eastern side due to sand blows occurring when rock was reached but this was eventually overcome and the cylinders successfully bedded on rock. As in the case of all bridges on this work cement concrete faced in stone was used in the abutments.

The Wak Oya—the river which supplies Labugama Reservoir with water—is crossed by an 80 feet span bridge with lattice girders having cross members carried on the lower channels. The bridge has roadway width of 18 feet and is founded on concrete wells bedded on hard cabook. The work was carried out entirely by the Government Factory and was the first unit to be completed.

Approximately 200 acres of land had to be acquired at a total cost of Rs. 405,000 Of this sum Rs. 90,000 was paid for acquisition of some three acres inside Colombo limits and the total figure included payment for about fifty dwellings mostly of the wattle and daub variety but with a few more substantial structures near Colombo.

The cost per acre varied very widely having a maximum of Rs. 50,000 per acre and a minimum of Rs. 500. The increased value of land due to the construction of the road is indicated by the fact that when additional small blocks had to be acquired towards the end of the work to adjust certain defects in the boundaries cost per acre had increased by some 300 per cent.

Approach Roads to Railway Stations

The estimates provided for the construction of connecting roads to Nawinna, Pannipitiya, Homagama and Megoda Railway Stations but, with the exception of Homagama, all these were omitted as the cost did not seem to justify them.

The road has been sign-boarded to meet modern requirements, standard Ministry of Transport indicators being used where necessary. As all junctions and crossings have been opened out to give ample view line the number of these required has been small and very few crossings or junctions were considered sufficiently dangerous to warrant their erection.

Concrete posts with individual sign-boards supported on direction arrows were adopted for all direction notices. These posts are 14 feet long eight inches across base and five inches across top flats and are reinforced with spiral wound steel similar to that adopted for telegraph posts.

The system adopted is to indicate the direction to Colombo and Avisawella on practically every post, the only other indication being to the nearest town *en route*.

Light Railways

Light railway track and trollies were largely used for transport of spoil and stone and the type adopted proved admirably suited to the purpose. This consisted of 16 lb. rails and 18 cubic feet side tipping wagons. This weight of rail is strong enough to carry a considerable load ; each section is light enough to be conveniently handled by two laborers and can be bent to form curves and straightened out again without difficulty. The 18 cubic feet trucks can be handled on a slope of 1 in 30 up by two laborers with a full load and when empty can be handled on the same gradient by one man.

Split cocoanut sleepers, to which rails were fastened by dog spikes, were used at first but, as the sleepers tended to split and the dog spikes to loosen, steel sleepers were substituted. These proved much more satisfactory except in very soft ground where they tended to sink but this was remedied by packing either split cocoanut stumps or blocks of stone under them. These sleepers are fastened to the rails by means of clips and bolts and it is necessary to keep a large supply of the latter in stock to provide for replacements as the bolts and nuts tend to rust badly, become bent and break when uncoupled.

Light rail track can be laid out to deal with almost any duty for which it is likely to be called upon by using plenty of switches and lead lines at each end and double working in between. In practice the capacity is usually controlled by the area of the cutting face and tipping point and single line working is all that is necessary. For single line working passing places should be provided at intervals of about one-eighth mile, trucks being worked in groups of from three to ten and passing places made of sufficient length to accommodate the number of trucks being worked. In providing for crossings for ordinary working it is advisable to have at least four sets of switches for every $\frac{1}{8}$ mile of track plus a few crossovers.

It was found that one laborer can push a trolley on the level for seven trips per day with a lead of $\frac{5}{8}$ mile ; for eight trips with a lead of half mile ; and nine trips for a lead of $\frac{3}{8}$ mile. Considerable time is usually wasted in the turn round with the result that long leads are relatively cheaper than short ones.

The cost of earthwork where trolley transport is used, can be split up into six main divisions :—(*a*) Cutting—This varies according to the nature of the soil being dealt with and the height of the cutting face but a fair average is four cubes per laborer per day, (*b*) Loading into Trucks—This is usually carried out by women and varies with the lead from cutting face to truck but a fair average with a lead of say 15 feet is one to one and a half cube per day, (*c*) Transport—Figures for this have already been given for work on the level but these must be varied if the lead is up hill or down hill. Provided the gradient being worked on is not more than say 1 in 100 the difference will not be great but, where the gradient uphill exceeds that additional provision must be made for what may be termed "trace laborers," *i.e.* extra men required to assist in pushing trucks up the gradients. As cuttings are usually above the levels of fillings the necessity does not often arise and the transport figures may usually be calculated for the level. (*d*) Tipping and Dressing Slopes—This is a variable which depends largely on the height of the bank but for a bank with average height, say six feet, about one laborer per twenty or thirty cubes tipped should be sufficient, (*e*) Contingent Items—This is for laborers required to extend the truck line ahead of the tipping as work progresses and for other minor works such as clearing stones or earth off adjoining roads and is naturally a variable. Three laborers are usually required for this work one of whom should be a fitter with a reasonable amount of intelligence. The cost of this depends directly on the sectional area of the bank but for banks of six feet high and 26 feet crest width costs worked out between five and 10 cents per cube.

It is easy enough to give average cost per mile by dividing the total cost by the length of road but this would be most misleading as the actual cost varied widely. The average cost worked out at Rs. 105,000 per mile. This can be divided up into two distinct parts namely where flood areas were crossed with heavy banking and bridging ; and where high land and no floods occurred and little bridging was required. The former cost approximately Rs. 215,000 per mile against Rs. 72,000 per mile for the latter despite the fact that costs of acquisition for the latter were much higher than the former. Supervision costs, apart from charges met from the votes for Personal Emoluments, only amounted to 1½ per cent of the total expenditure and contingencies to 3½ per cent.

Sections of the road at both ends were opened to traffic in 1929 and 1930 as soon as they were ready and further sections were made available to the public as completed till the whole road was opened to through traffic on March, 19 1932. Progress had to be slowed down in 1930 due to the financial stringency. Had this not been necessary the road would probably have been opened about the end of September, 1931.

The Russian Gold Industry

A Moscow Correspondent writes : In Russia the gold industry has made great strides during the last four years, and now has reached a stage when rapid increase of production is likely to follow. Up to the beginning of the Five-Year Plan gold was in a sense the step-child of the Soviet's industrial program, both for practical and political reasons. The gold fields are almost wholly situated in Siberia, where labor is scarce, the distances enormous, transport primitive and the winters the worst in the world.

Despite this, it might have seemed that the Kremlin would have preferred to force gold production at all costs to pay for purchases abroad instead of exporting foodstuffs, oil, coal and other materials badly needed at home. But the Kremlin does not reason like capitalists, and it chose a different path. The object of its export policy has been to pay for purchases. But there has also been the thought of re-conquering the foreign markets of Czarist Russia. More important still, the Kremlin aims at industrializing the country from the ground up ; that is, by building plants to make machines to mechanize industry and agriculture rather than by buying such machines ready-made abroad. Industrially speaking, that is the fundamental meaning of the Five-Year Plan.

Some three years ago one of the ablest of Bolshevik executives, M. Serebrovsky, who had successfully reorganized the oil industry, was appointed head of the gold trust. Educated abroad, with full command of French, English and German, M. Serebrovsky has a wide first hand experience of different phases and localities of foreign gold mines. By air-plane, rail, river, horseback and reindeer sled he covered thousands of miles in Soviet Siberia during the past two years in order to make a personal investigation of the gold fields and the future of the gold industry. In a recent article in the *Pravda* he outlined the remarkable work already done, and the infinitely greater possibilities ahead.

M. Serebrovsky makes it clear that the Soviet is going resolutely forward with its own mechanization program for the gold industry. Industrial centers are being developed for various goldfields with a view to producing the equipment needed. Already a greater proportion of the dredges are of Soviet manufacture, and the same applied to stamp crushers in new mines, the number of which is steadily increasing as compared with the pre-war practice, which was mainly placer mining.

In short, what the Russian gold industry wants from abroad is equipment to produce dredges, crushers and drills, equipment to develop power stations, equipment to build locomotives and rails for broad and narrow gauge railroads, to build steamers and barges for rivers. In the gold industry a beginning already had been made along those lines, although it goes without saying that foreign capital would be welcomed to hasten and facilitate transport, electrification and mechanization no less in the gold industry than elsewhere.

In any event, there is little doubt that gold production will be largely increased in the near future, despite the fact that owing to distance and climate it requires an average of three years to get a quartz or pyrite mine going when the actual construction works takes 18 months or less. The Soviet gold production is estimated at about £8,000,000 for the year 1931. Official figures gave 67,000,000 roubles, or £6,720,000 (at par), a figure little superior to that for 1913. But they failed to take into account "by-product" gold from zinc, copper and silver mines and purchases from private or private producers, prospectors, etc., which undoubtedly would bring the total up to about £8,000,000, at par.

Several valuable new mines have been opened in the past twelve months, and although they are not yet approaching the peak of production, should bring this year's total somewhere between £10,000,000 (at par) and £12,000,000, and possibly this figure will reach £20,000,000 by 1935 without foreign co-operation. Exploration and prospecting now being carried on throughout Siberia from the Urals to the Arctic and Pacific Oceans, reveal fresh mine deposits practically every month.—*The Mining Magazine.*

Commercial Aviation in Japan

(*Continued from page 447*)

government support will be necessary to carry out this plan, and a delay until 1934 is anticipated.

The company further reports that the extension of facilities now underway is confined to the construction of 38 new airway beacon lights along the 1,905 kilometer route between Tokyo and Hukuoka, Kyushu.

Operating statistics for periods beginning October, 1928 and ending September, 1932, are reported by the company as follows:

Period	*Total kms. and miles flown*	*Total flying hours*	*% increase in passengers*	*% increase in freight*	*% increase in mail*
October, 1928 to March, 1929	21,450 kms. 13,328 mls.	—	—	—	—
April, 1929 to September, 1929	600,574 kms. 373,178 mls.	4,063	1	1	1
October, 1929 to March, 1930	742,980 kms. 461,665 mls.	4,430	1.73	1.3	1.01
April, 1930 to September, 1930	897,749 kms. 557,834 mls.	5,385	4.11	4.81	1.69
October, 1930 to March, 1931	992,890 kms. 616,952 mls.	5,873	3.28	4.2	2.08
April, 1931 to September, 1931	986,580 kms. 613,031 mls.	5,891	3.26	7.10	2.81
October, 1931 to March, 1932	1,214,247 kms. 754,497 mls.	7,150	3.3	12.6	3.7
April, 1932 to September, 1932	1,322,124 kms. 821,528 mls.	7,710	4.7	12.6	4.65

The latest statement of accounts covers the period from April 1, 1932 to September 30, 1932, and shows that the Japan Air Transport Company made a net profit of Y.214,658, with receipts totaling Y.1,744,988.

Commercial and Industrial Electric Heating in Japan*

By YOSHIJIRO ISHIKAWA, Managing Director of Kyoto Electric Light Company, Kyoto, Japan

I. Development of Commercial and Industrial Electric Heating in Japan

APART from some large electric furnace, or in applications which are impossible except by means of electric power, the first electric heating shown to the public on a comparatively large scale was the adoption of 24 electric cook stoves, made in Germany, each 1.5 kw., by Harihan, one of the best known Japanese style restaurants in Osaka, in 1915. In the same year, when the Grand Ceremony of the Imperial Enthronement (Emperor Taisho) took place in Kyoto, the mayor of the city invited all princes, nobles and high officials who attended the ceremony to the Yasaka Club Hall, the then largest public hall built in Japanese style in the city. The season being mid autumn, the rooms were all equipped with electric heaters, 36 in number and 150 kw. in total capacity. This pioneer show, which continued for several days, was received by the public with curiosity and admiration, and although it was a temporary installation, the public gained some knowledge of the adaptability of electric power for room heating.

As the first commercial electric heating on a small scale, laundry irons were used in Kyoto from 1916 or thereabouts.

The competition with low price fuel and the inefficiency of the apparatus during this early stage were two main drawbacks to the general adoption of the new electric system.

Application of the new motive power to hot rolls (Schreiner rolls) in dye-works was tried during this period, but the result was a failure.

Soon after this came the memorable motor power boom. For almost five years during and after the European War, the demand for motor power grew so keen, with limited supply, that there was practically no power for other purposes, which delayed heating development.

The economic crisis after the War that demolished large numbers of bubble schemes caused a large surplus of power, which increased with the completion of new generating stations planned during the boom period.

On the other hand, improvements in the manufacture of resistor wires and heating apparatus, and the rise of fuel prices, one followed by the other, changed the general conditions of the heat utilizing industry to the benefit of the electric supply company. The example of the Imperial Hotel Co., Tokyo, was epochal. It was in 1922 they decided to electrify all their heat, including cooking, room heating, laundry and other departments in their new building.

In 1922, in Kyoto, an electric tenter heater and "Yuba" (foodstuff made from beans) heating pans were the first pioneer applications of commercial heat in the purely native mode.

In individual homes proprietors began to inquire about the electrification of their equipment, thus demanding new designs, leading from the original simplicity to a more complicated mechanical equipment as well as an increase in kw. output capacities.

The demand for electric heat has been increased to a marked degree as shown in Fig 1. At the end of 1930, the total electric power for heat utilization reached 379,192 kw., supplying 207,763 customers. That is, the connecting load for electric heat was 43 per cent of 887,700 kw. used for electric light, and 14 per cent of 2,668,740 kw. used for electric motors.

Comparing the connected load for electric heat in 1930 with 73,333 kw. in 1925 it shows an increase of about five times in five years a wonderful development in the utilization of electric heating during these years.

TABLE I. ZONAL DISTRIBUTION OF ELECTRIC HEAT CONNECTED LOAD IN KW.

	1924 *kw.*	*1926* *kw.*	*1928* *kw.*	*1930* *kw.*
Kanto	4,777	28,336	74,962	93,660
Chubu	3,940	14,466	32,647	36,110
Kinki	31,715	75,006	129,487	182,900
Shinetsu	351	499	6,347	12,092
Hokuriku	301	624	1,434	5,810
Chugoku	376	3,692	18,307	26,240
Tohoku	9	103	803	1,960
Shikoku	419	630	2,191	2,990
Kyushu	1,701	3,722	13,288	13,970
Hokkaido	93	269	3,346	3,460
Total	43,682	127,347	282,812	379,192

Remarks:—Those installations not in actual service are excluded from this table.

Table 1 gives the total electric power for heat utilization, divided according to zones.

From this table, it is easily seen that the Kinki district including Osaka, Kyoto and Kobe, has always led other districts since the early preliminary period.

Of the total electric heat in the above table, what percentage is for commercial and what for industrial purposes is difficult to know, there being no dependable data.

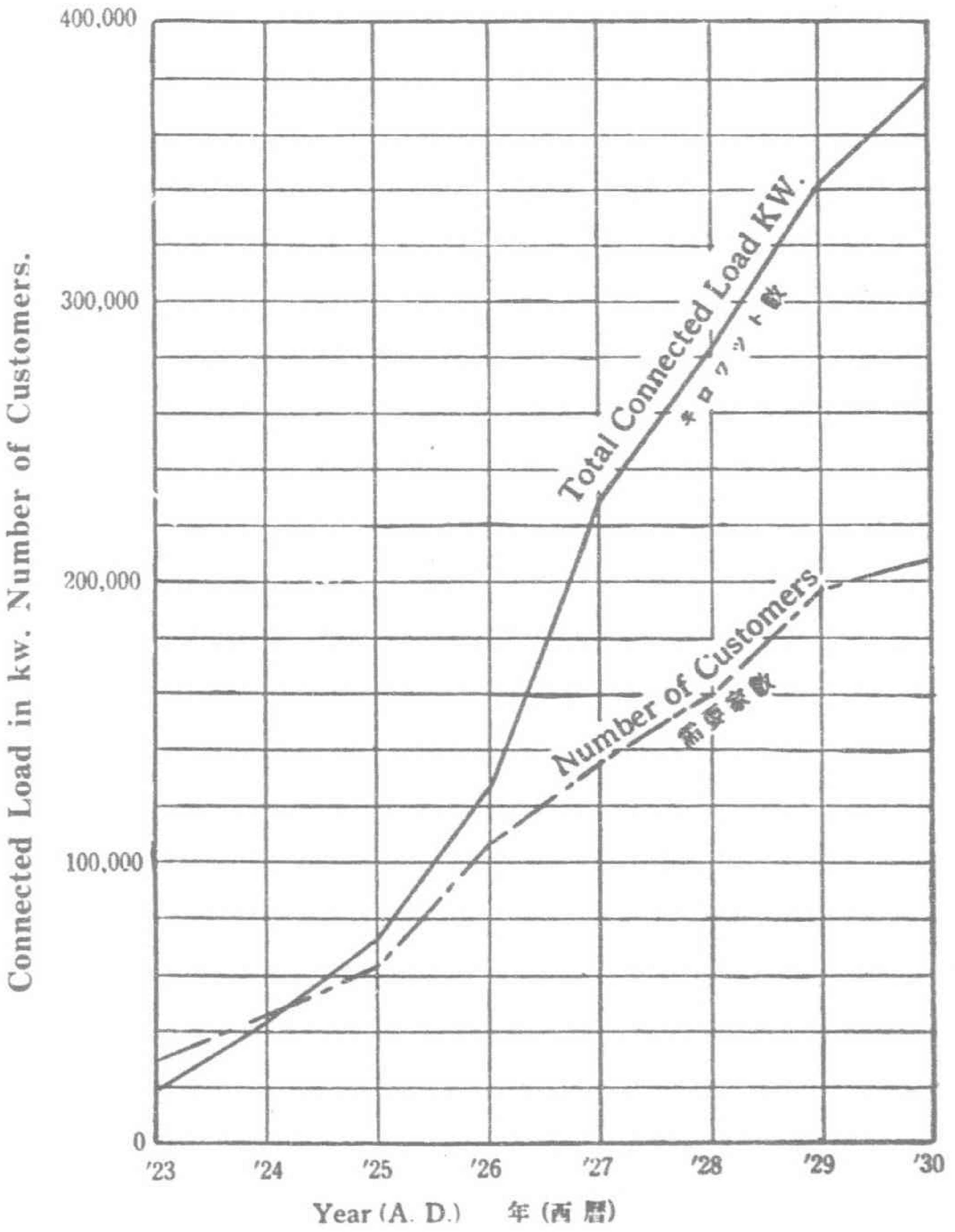


Fig. 1.—Yearly Increase of Electric Heat Load

II. Commercial and Industrial Heaters in Japan

The native mode of living being so different from that of the West, general commercial and industrial conditions also differ in many respects. Appliances originally designed and made in Europe and America may not suit the Japanese fashion and need some change either in form or in detail, excepting some few such as cooking appliances or the like.

Of kinds of commercial and industrial electric heating appliances of special native use, some of purely original designs, the following brief explanation may be given.

1. *Electric Heaters for Tenters.*

The tenter is the machinery in dye-works used for dressing textile widths that have shrunk while dyeing, by stretching both edges with clips and applying heat for drying humidified cloth while it is moved over the heat. Formerly, charcoal, gas and steam were the sources of heat with their respective inherent drawbacks. Electrification experiments were first tried in one of the dye-works in Kyoto in 1918 and satisfactory working conditions were established in November, 1922. The heating elements is arranged in such a way as to suit the different widths of cloth to be treated (Figs. 2 and 3). In case the moving of the cloth stops, charring or burning is prevented by means of a shutter partition with a simultaneous lowering of the heating source. All such combinations of new devices have perfected the tenter and have removed the drawbacks experienced with other forms of heat, that is, unevenness of heat, spoiling and charring of cloth.

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*Japan Nickel Review.

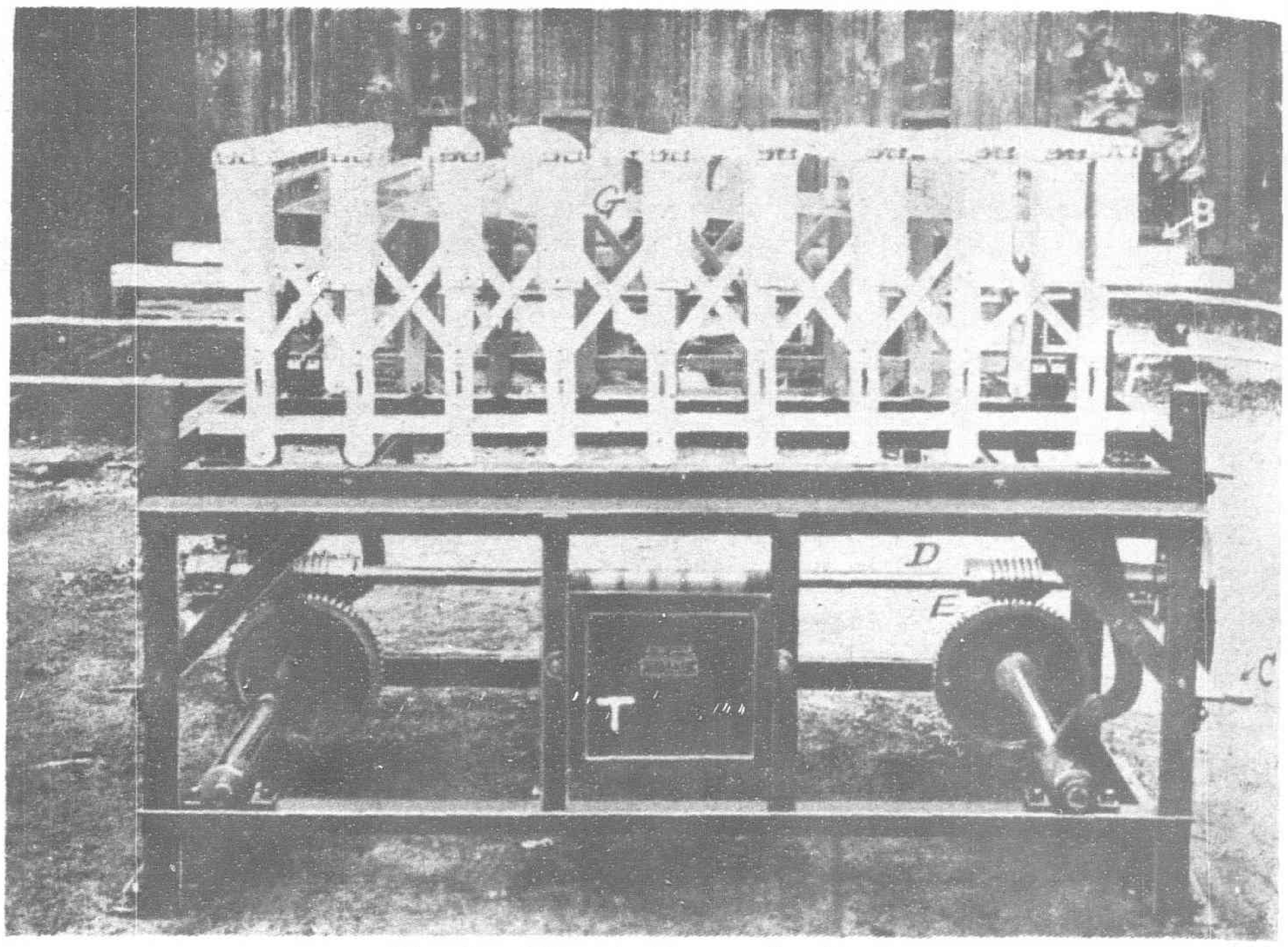

Fig. 2.—Electric Heater for Tenter

A—Heater	**E—Worm Gear for above**
B—Adjusting Link for changing width of Heater	**F—Terminal Box**
C—Handle for Lifting and Lowering Heater	**G—Reflector of Nickel Plated Sheet Metal**
D—Worm Gear for above	**T—Voltage Regulator**

Shutter Cover as Safety Device is put on Tenter Frame and is not shown in above Picture

(2) *Induction Type Electric Drying Heater (Japanese Patent No. 40,856).*

This is a type of heater of original Japanese design, its meritorious points being that the current-carrying parts are all put in a cold condition and the heat-generating parts consist of non-laminated iron. The primary magnetizing current is made to produce eddy currents in the non-laminated iron which is all converted into heat by Joule's law and is to be recommended for such cylindrical dryers as only used in dye-works. Formerly, steam was the heat source for this kind of work, and was most uneconomical and always a source of trouble in maintaining good working conditions. On the other hand, in the induction type heater the cylindrical iron itself being the heat generator and at the same time acting as drying surface, the action is very direct; also the advantage of a comparatively large temperature coefficient of the resistance of iron is made use of for obtaining almost as favorable a characteristic as that obtained by the use of steam. Besides, there is no danger of breakage owing to the vacuum due to condensation in steam heated cylinders, and in economy for intermittent use it cannot be excelled by any other form of heat can excel it. The latest type consists of two cylindrical drums of different diameters, one put concentrically inside of the other, the inside drum carrying the primary current,—two cylinders and end plates forming complete magnetic circuits, while the outside cylinder of iron plates is designed to carry on over flux density and hence to give better heat generating effect and exposed to work as drying cylinder. Fig. 4 shows the latest type. The simplicity and rigidity, both mechanically and electrically are apparent from the illustration.

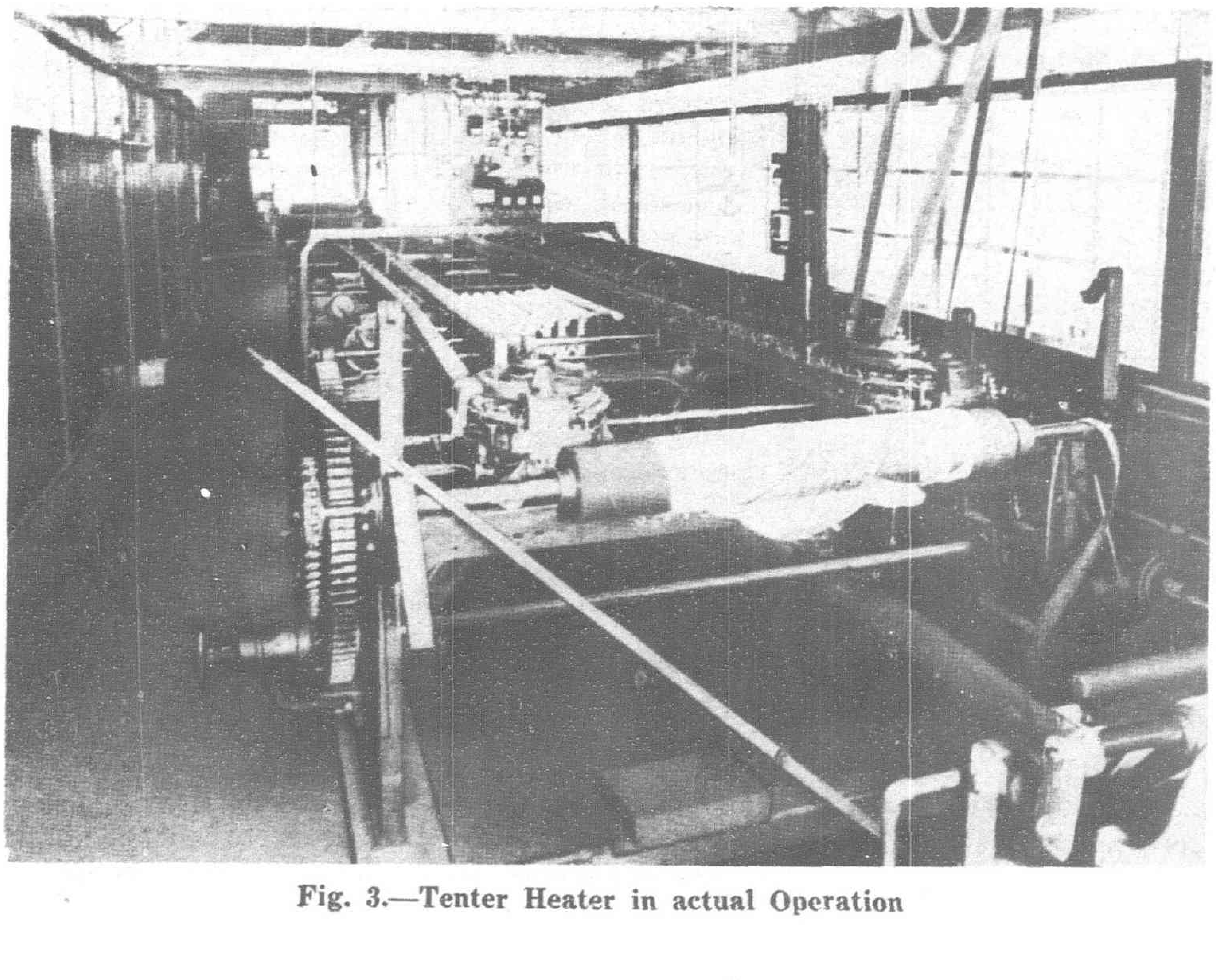

Fig. 3.—Tenter Heater in actual Operation

(3) *Electric Singeing Machine (Japanese Patent No. 77,469 and No. 78,689).*

Singeing is a process of burning lint from cloth to make the texture smooth before printing and is a very important process in the textile industry. Formerly, this was done either by exposing the cloth to a gas flame or sliding the cloth on a red hot copper plate fabricated in a cylindrical shape and heated by coal or oil. Since the electric singeing machine was first designed and satisfactory results were obtained in 1927, many improvements have been made in this process.

A heating element has recently been made for the machine shown in Fig. 5. In this device the electric resistor is made of a nickel chromium alloy ribbon which is connected alternately from both sides. By the electric current passing through the resistors singeing is performed by sliding the cloth continuously. In Fig. 6 a singeing machine complete with heating element and other necessary parts is shown. "A" indicates the terminal of the resistors. "B" is an automatic safety device to prevent the burning of the cloth if the sliding motion is stopped. "C" is a suction pipe connected to an exhaust tank where gas produced during the singeing process is stored. "D" is a drum provided for preheating the cloth with such exhaust gas. A, B, C and D are important improvements recently made on Singeing Machines. In spinning companies, such as Kanegafuchi, Nippon Toyo these machines are widely used.

(4) *Electric Heating Schreiner Roll. (Japanese Patent No. 43,109).*

This machine is provided with a roll grooved with numerous small lines on its face and is used to produce an intense lustre on textiles by rolling and heating as a finishing process. At the present time better results are being secured by electrification than by the gas heat formerly used. Fig. 7 shows the construction of the above-mentioned roll. The patented "Sheath Wires" act a as heating element and are provided along the internal wall of the bore in the roll. The space between each wire is cast with alloy which melts at a low melting point (about 300°C), while the inside of the roll is filled with an insulating substance. As the " Sheath Wires " are connected thermally to the main part of the roll, heat is well distributed and the thermal efficiency is very high. The electric current is conducted by a slip ring as a heating element and is rotated with the roll.

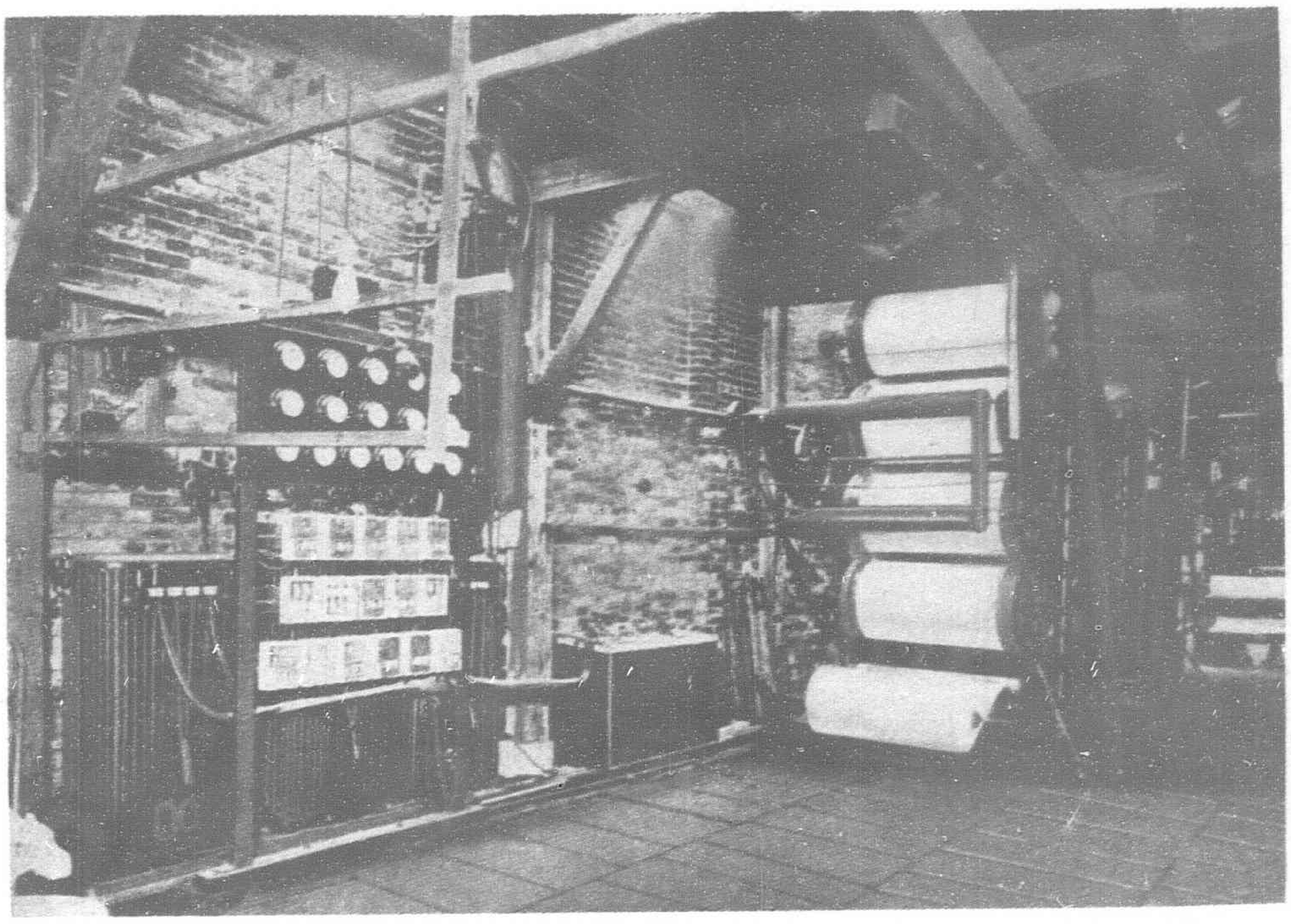
Fig. 4.—Induction Type Cylinder Dryer. Single ph 200-V., 180 kw., 58 cm. diam., 100 cm 1 each

(5) *Glazing Kiln Heater in Porcelain Industry.*

Porcelain decorated with pictures, patterns and colors is generally put in a special kiln for finish as the secondary process (Japanese Kingama, the glazing kiln). Formerly, the heat treatment was effected in an old type kiln, the articles being put in a casing and exposed to the wood-fire flame.

In 1924 when the Naigai Electric Heating Apparatus Co. first introduced the electrically heated kiln and demonstrated the adaptability of electric heat for this kind of work. In Nagoya, the great center of the porcelain industry, advantage is taken to utilize the low rate electric energy after midnight, in such way that the kiln is well prepared and filled with pottery to be treated during the daytime and made to await the low rate hour to switch on the current. Fig. 8 is a view of one of the Nagoya factories with such a kiln. Fig. 10, shows one in a private shop in Kyoto.

(6) *Multiple Unit Rice Cooker.*

To cook rice properly to meet the Japanese taste, which is somewhat different from that of other rice eating nations, is a difficult task in the old-fashioned fireplace with wood fuel, especially in cooking a large quantity. The simplicity and convenience of electric heat, the multiple-units cooker, has solved all rice cooking problems. Such units can be used one on top of the other in piles, thus economizing space (Fig. 9). The 3.5 kw. unit has capacity enough for 7.5 kilograms of rice.

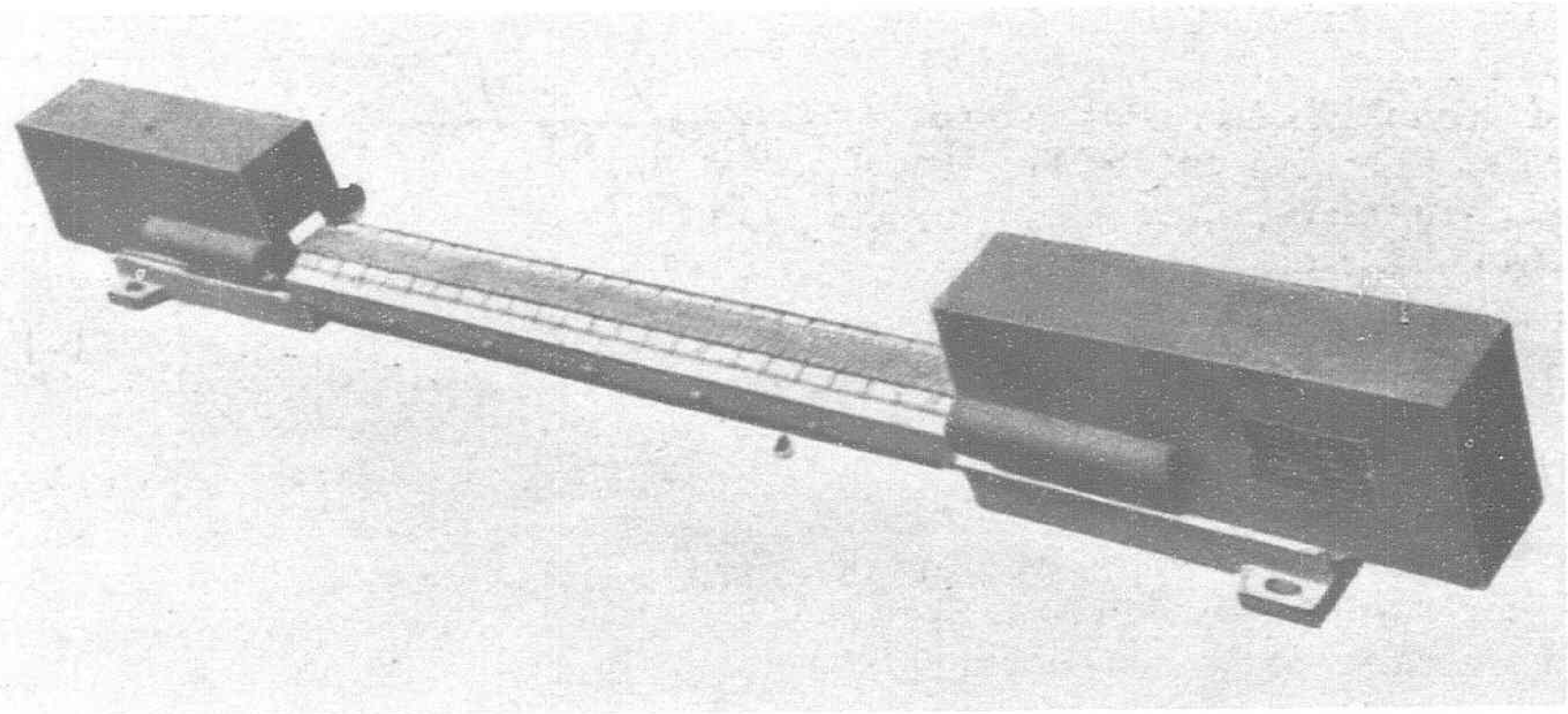
Fig. 5.—Cloth Singeing Electric Heater, Single ph., 50-V., 25 kw.

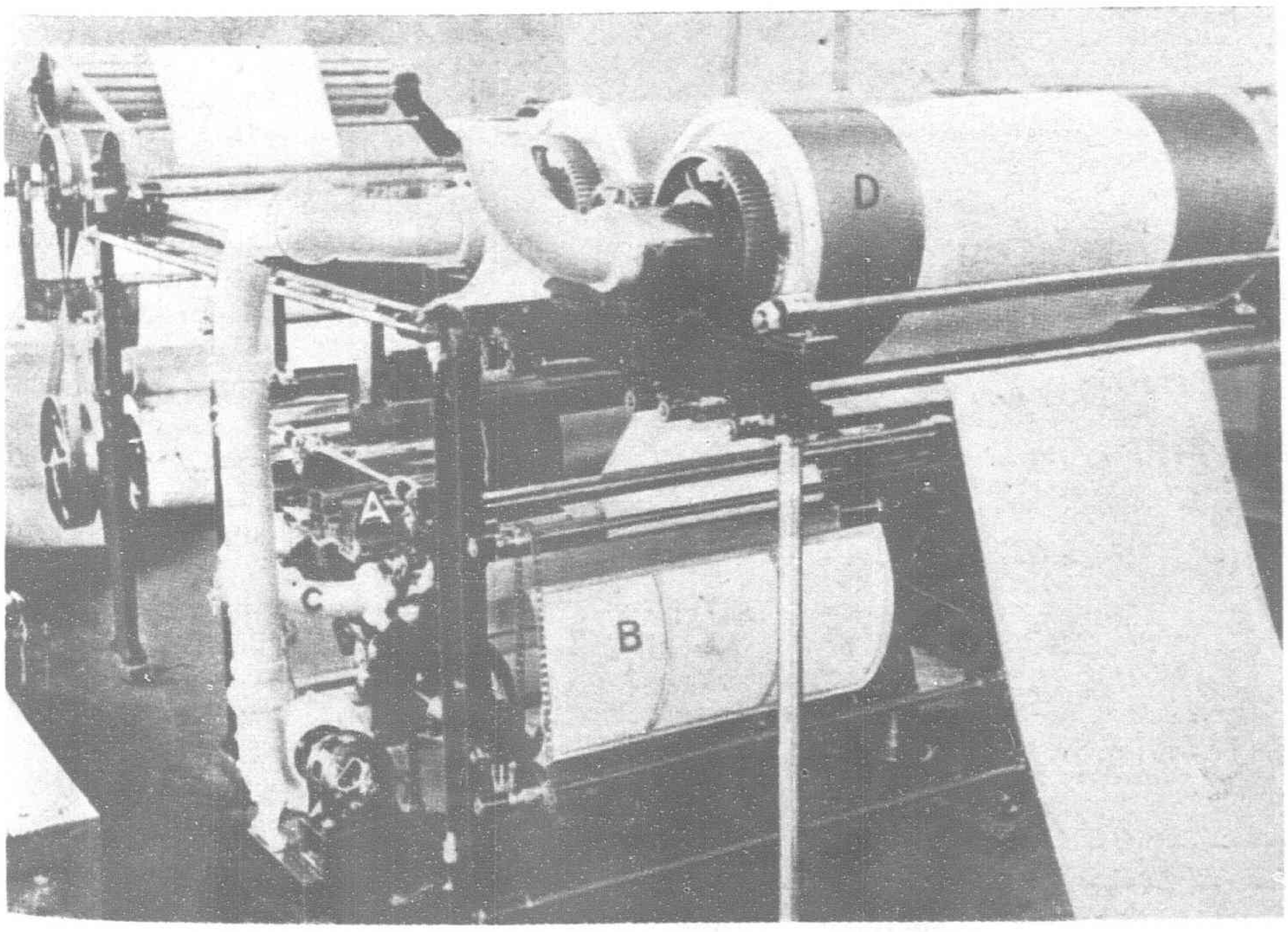

Fig. 6.—General view of Electric Singeing Machine

A—Heating Element (showing terminal)
B—Shutter of Safety Device
C—Combustion Gas Inducing Device
D—Cloth Preheating Cylinder

Singeing Efficiency 33,600 yds. per hour Single Phase 37 kw.—66 kw.

(7) *Electric Eel Broiler (Japanese New Design 115,922).*

Broiling known by the name of " Kabayaki," especially applied to eels opened lengthways with spines removed is a very popular and common item in the menu of the Japanese restaurant. A special kind of charcoal was for a long time the source of heat, until the first electrification succeeded in Kyoto in 1927. To minimize the renewal of the heating element which is subject to the deteriorating action of dripping fats and sauces, heavy conductors of nickel-chromium such as B.S. No. 1 are used at reduced voltage from special transformers appended, and the heat control made on the primary side of this adjunct transformer. Fig. 10 shows general view of nine such sets, with total capacity of 81 kw.

III. Tariff Rate for Commercial and Industrial Electric Heating

The common practice is to adopt the same rate both for domestic heat and motor power. For special application, whole charges are made on a contract basis per month. For some large power users heat-charges are included in the same meter as power on the same basis. Sometimes such charges are fixed with special low rate as an inducement to new customers.

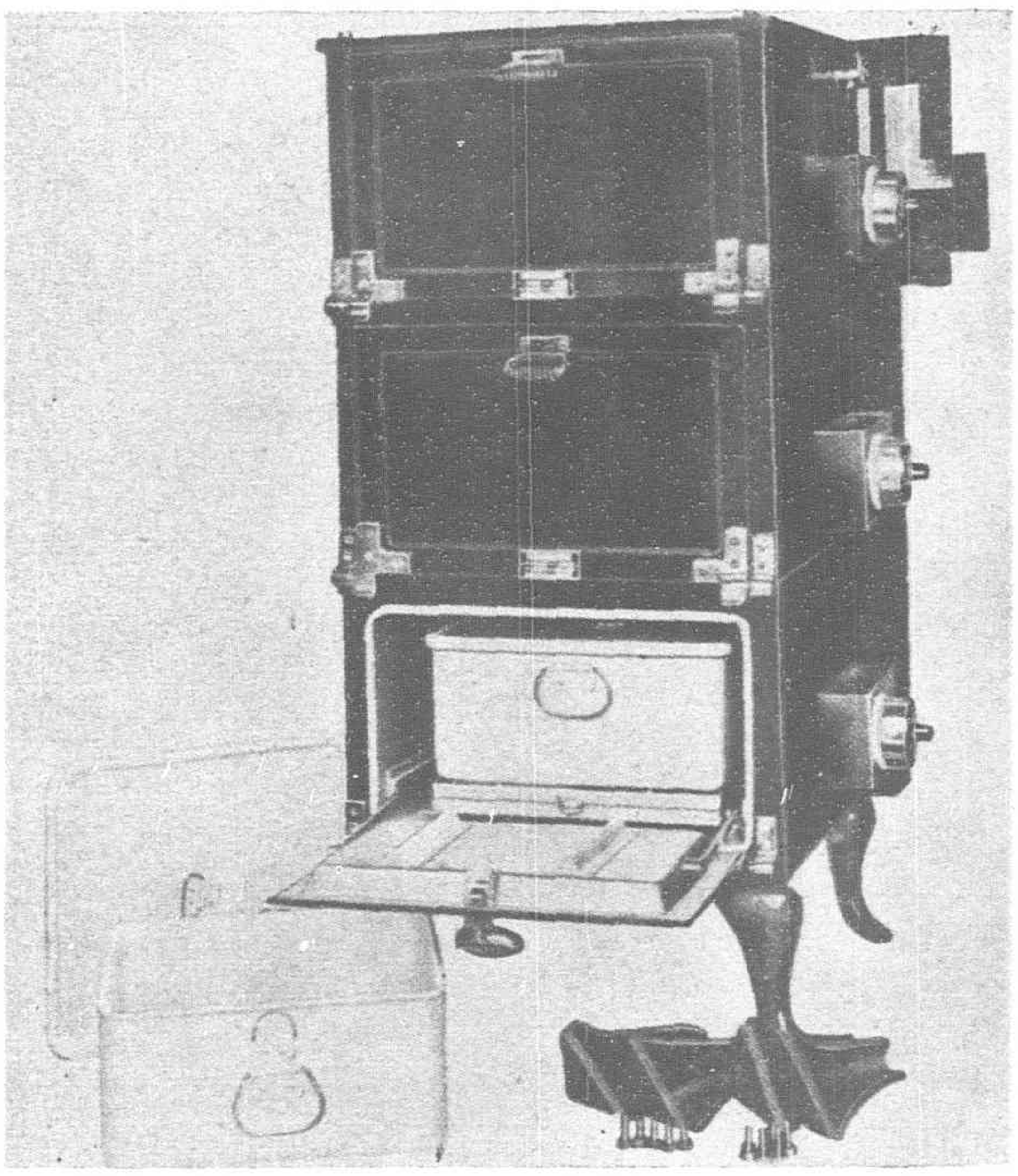

Fig. 9.—Multiple Unit Rice Cooker. Capacity: 3.5 kw. each

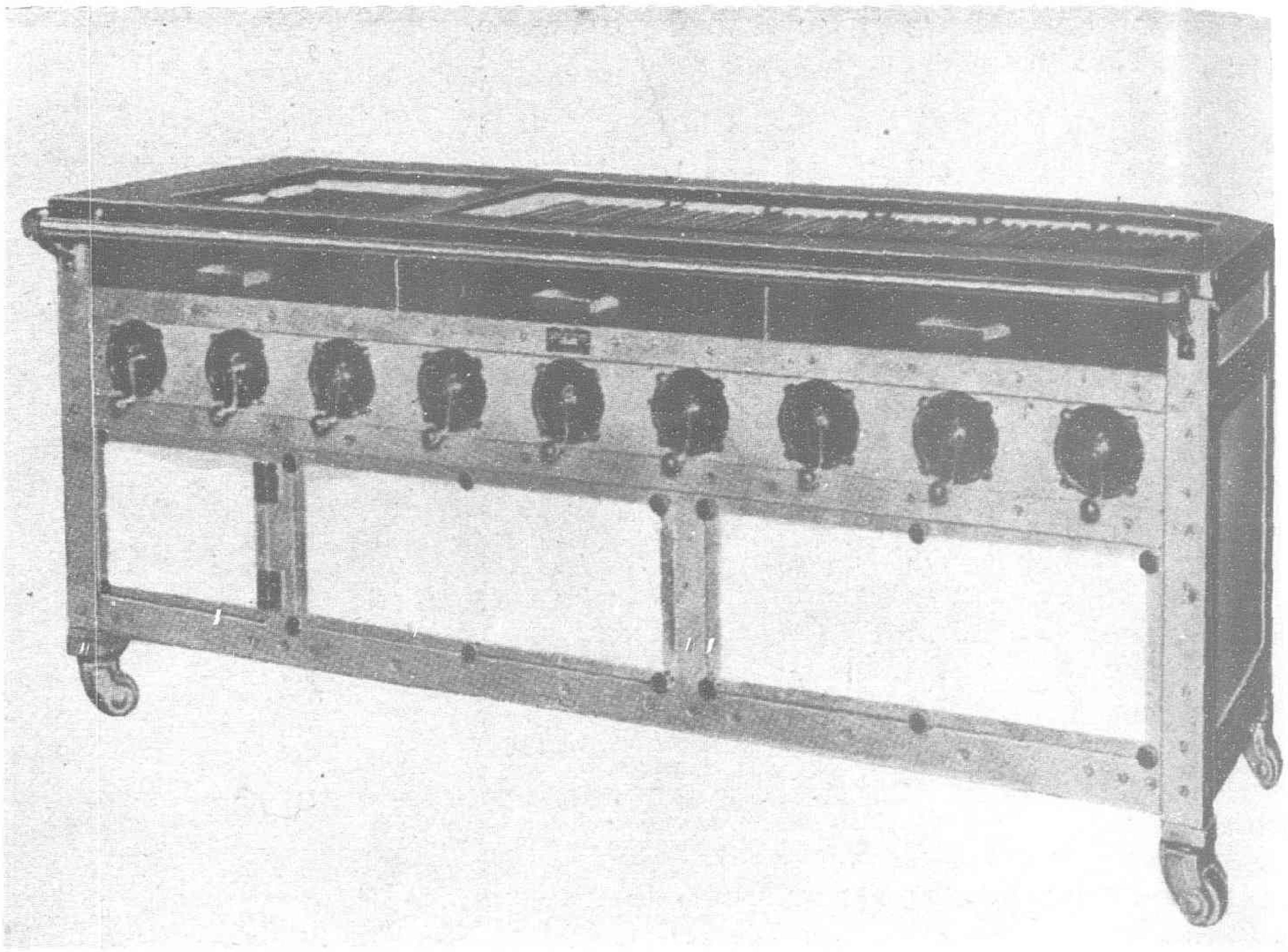

Fig. 10.—Electric Eel Broiling Outfit. Total capacity: 81 kw. (9x9 kw.)

The double rate system may be mentioned here as a means of encouraging the midnight use of power. The Kyoto Electric Light and Toho Electric Power Companies adopted double rate system with profitable results both to suppliers and consumers, and the example is being followed by the other electric companies. Although the straight flat meter rate is most common, still some companies adopt a cut rate on a sliding scale system above a fixed minimum of consumption.

Regarding the guarantee of minimum income of the supply companies, the companies in the six large cities adopt the minimum charge system, Y.1.10-Y.3.00 per kw. installed.

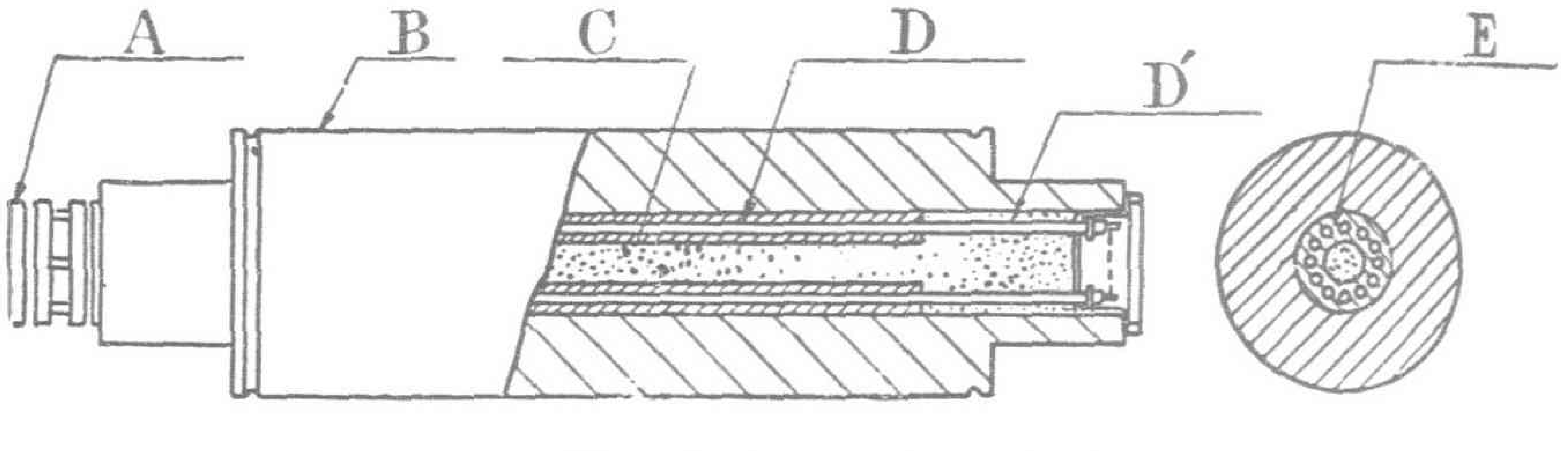

Fig. 7.—Electric Heater for Schreiner Roll

A—Slip Ring
B—Schreiner Roll
C—Heat Insulation
D, D'—Sheated Wire Heater
E—Fusible Alloy

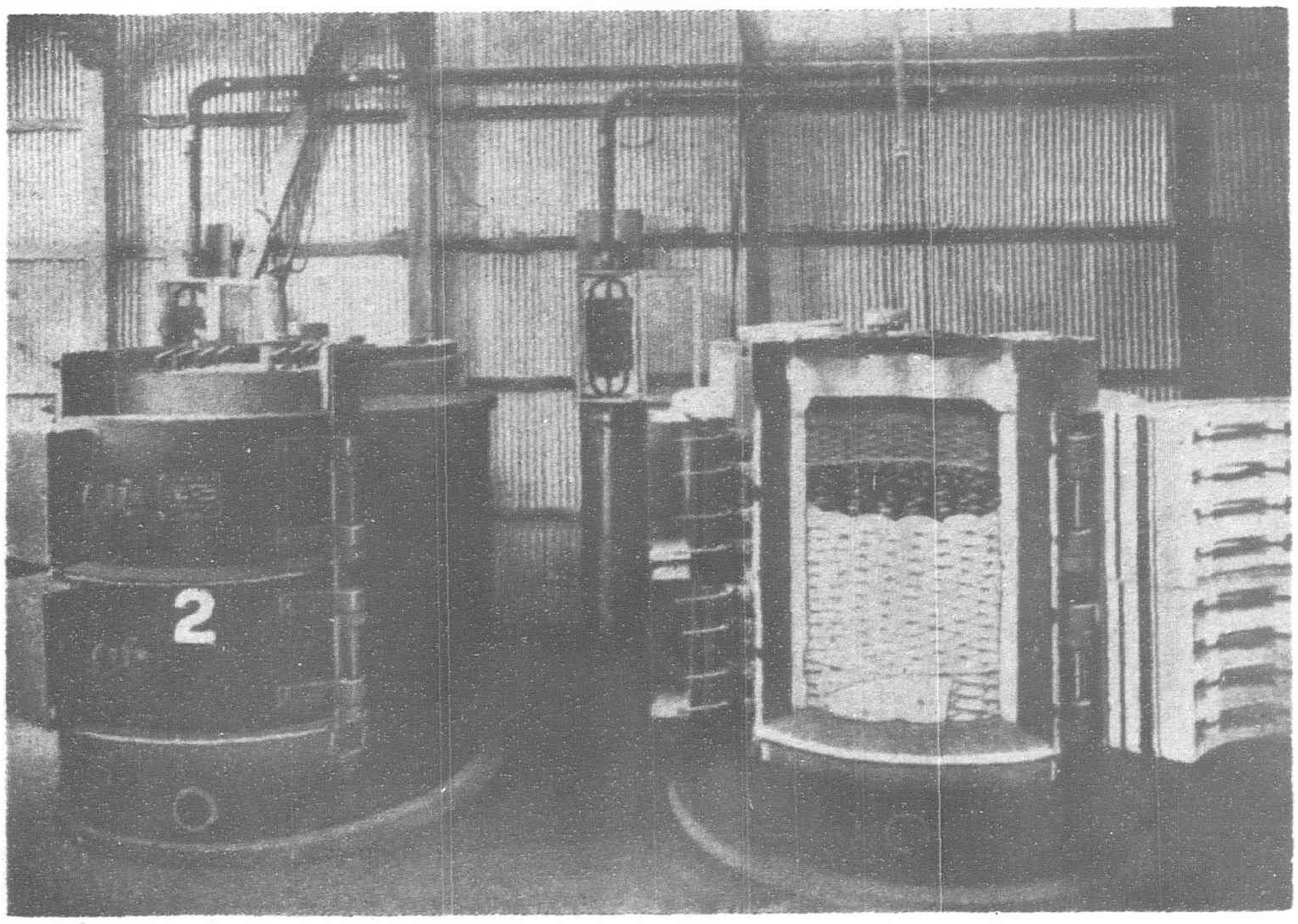

Fig. 8.—Electric Glazing Kiln. 3ph. 200-V., 50 kw.

Chinese Railways

The Chinese Ministry of Railways proposes a capital expenditure of £4,500,000 on linking the Kwangtung Railway at Shiuchow with the Hukuang Railway at Chuchow with the object of completing the long-contemplated line between Hankow and Canton. Towards this object Boxer Indemnity funds in London will be indented for materials costing £1,650,000 to be supplied during the next four years. The Board of Trustees has practically approved the project, but negotiations with the banks for the flotation of a loan are affected by the fact that China declared a moratorium on the Indemnity payments in 1932, and that since the expiration of the moratorium she has allowed payments to fall in arrear.

The old project of a railway from north to south is being revived in Shansi. It was talked about and prospected in 1902, and many times since. As a change from the old talk of exploiting Shansi's mineral wealth, the bait of more convenient transport of grain as a famine preventive measure is to the front. The Nanking-Shanghai Railway Administration has drafted a proposal for the reconstruction of the demolished sections of the North Station at Chapei. After last year's Sino-Japanese hostilities at Shanghai, it was planned to build a new station at Chenju, but owing to financial difficulties, this has had to be abandoned. A railway between Canton and Swatow is planned by the Kuangtung Provincial Government. It is estimated that $40,000,000 is needed, and the money is to be raised by public subscription. Contracts have been signed by the Lung-Hai Railway for the construction of the next 39 kilometers of the railway to Weinan, Shensi. Extension from Tungkwan, on the Shensi-Honan border, commenced last year, has been completed to about 30 kilometers west of that city. From Weinan, the line will continue toward Sian, provincial capital of Shensi, a distance of about 60 kilometers.

The Nankow Pass on the Peiping-Suiyuan Railway*

By T. KING, Chief Engineer, Peiping-Suiyuan Railway

In May, 1905, the Imperial Chinese Government decided to build a standard gauge railway between Peking (now Peiping) and Kalgan, employing only Chinese engineers and making use of part of the annual surplus from the Peking-Mukden Railway, then the Imperial Railways of North China. The late Dr. Jeme Tien Yu was appointed Chief Engineer of this new Railway. Work was begun in October 1905, and the whole line was open to traffic in September 1909. The main line then built started from Fengtai, a suburban town south-west of Peking and a junction station of three important railways, viz: the Peking-Mukden, the Peking-Hankow and the Peking-Suiyuan; and terminated at Kalgan, a trading center on the Mongolian border, covering a distance of 125 miles, now a part of the Peiping-Suiyuan Railway. According to the report submitted in 1909, the total cost amounted to Tls. 6,935,086. The foregoing cost included, among other items, the following:

(*a*) A branch line from Hsichihmen station (at Peking) to Mentowkow, 16.13 miles.
(*b*) A branch line from Sia Hwa Yuan station (35.7 miles from Kalgan) to Che Ming Shan Coal Mine, 1.53 miles.
(*c*) Che Ming Shan Coal Mine, operated by the Railway.
(*d*) 19 locomotives and 328 cars.
(*e*) A central mechanical works at Nankow.

While comparatively heavy and costly work can be found here and there throughout the whole line, such as the bridges over the Sha River (near Peiping), over the Yung Ting River (on the Mentowkow branch) and over the Hwai Lai River (near Hwai Lai station), and the sidehill work along the Yang River in the vicinity of Sia Hwa Yuan station, etc. etc., the most important and difficult part of the work was to push the line through the so-called "Nankow Pass," the successful completion of which has won for Dr. Jeme such a national and international reputation as has been enjoyed by but few of the Chinese Engineers. The following is a brief description of the Peiping-Suiyuan Railway through the Pass as is found to-day. For a general plan of the Peking-Kalgan Railway, see Fig. I.

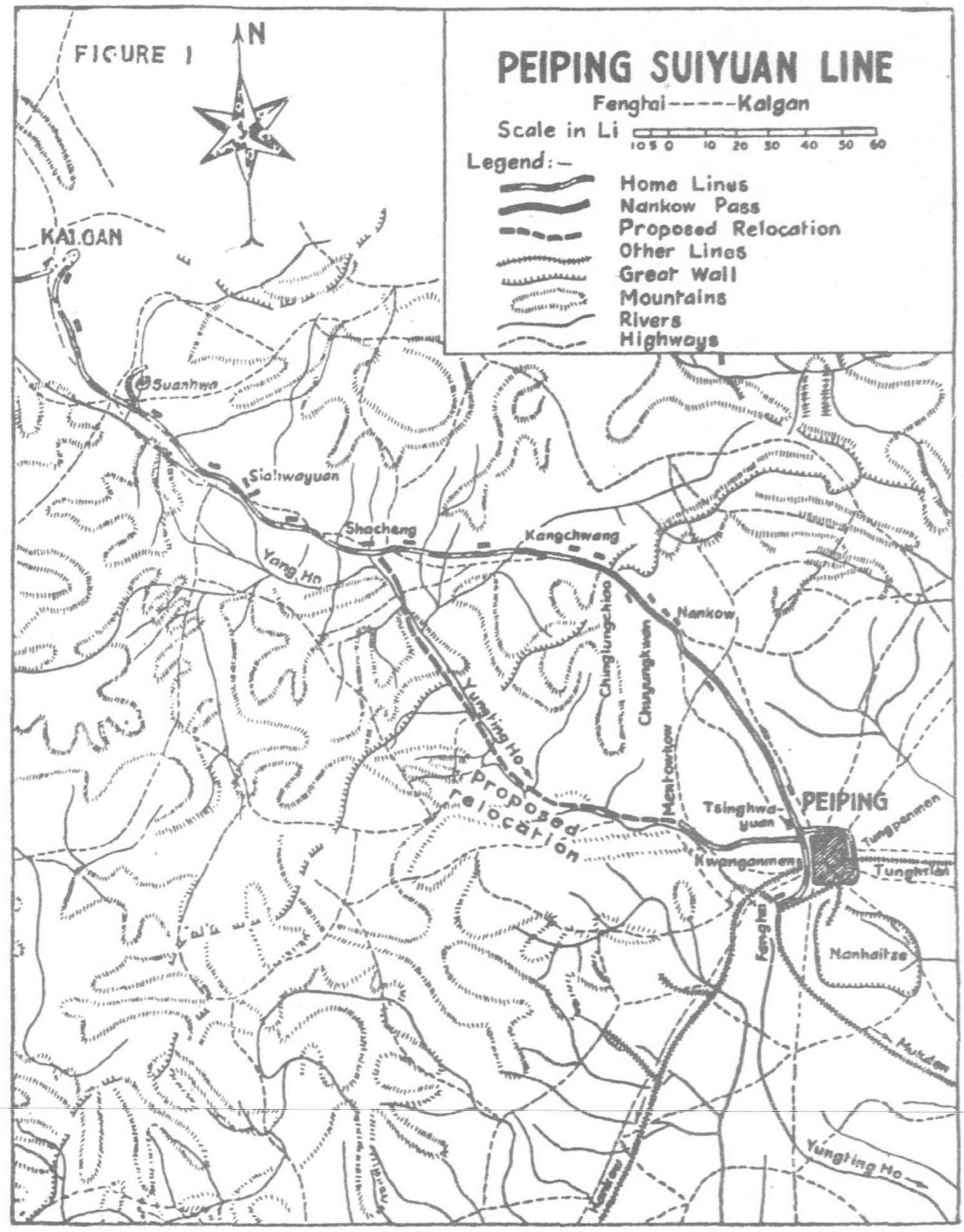
FIGURE I

Alignment

The first 28.34 miles from Fengtai (Elevation† = 117.8-ft.) to Chang Pin Hsien (Elevation = 146.24-ft.) runs on a flat plain, while the next 5.8 miles from Chang Pin Hsien to Nankow (Elevation = 315.00-ft.) continues on a rising grade with a maximum grade of 1 in 100 or 1 per cent. The line from Nankow to Kangchwang, popularly known as the Nankow Pass, follows the main road up a natural valley, used by caravans and carts ever since the beginning of the Chinese civilization.

Table I shows the elevations and distances from Fengtai to all the stations in the Pass, as well as average grades between stations.

TABLE I.

Station Name	*Abbreviation*	*Elevation in feet*	*Distance in miles from Fengtai*	*Average grade*
Nankow ..	NKW	315.00	34.155	
Tungyuan ..	TYN	589.00	37.635	1 in 66.8 or + 1.5%
Chuyungkwan ..	CYK	1,052.68	40.450	1 in 32.1 or + 3.1%
Sanpu	SPU	1,466.55	42.848	1 in 30.6 or + 3.3%
Chinglungchiao .	CLO	1,841.00	45.340	1 in 35.1 or + 2.8%
Hsipoutze ..	HPT	1,800.98	48.982	1 in 4,800 or – 0.2%
Kangchwang ..	KCW	1,635.00	52.695	1 in 118 or – 0.85%

TABLE II.

From Station	*To Station*	*Distance in miles*	*Sharpest Curvature, Radius in feet*	*Maximum grade, uncompensated*
NKW	TYN	3.480	1000	1 in 40 or + 2.5%
TYN	CYK	2.815	700	1 in 30 or + 3.3%
CYK	SPU	2.398	700	1 in 30 or + 3.3%
SPU	CLO	2.492	600	1 in 30 or + 3.3%
CLO	HPT	3.642	600	1 in 32 or + 3.1% in one direction 1 in 62 or – 1.6% in other direction
HPT	KCW	3.713	5000	1 in 70 or – 1.4%

Table II shows the actual maximum grades and sharpest curvatures of the main line in the Pass.

In this 18.54-mile section, there are altogether 51 curves, with an aggregate curve length of 6.51 miles. Considering only the NKW-HPT section, there are 50 curves, with a total length of 6.03 miles in 14.83 miles of the main line, i.e. in every 1,000 feet of main line, there is a curve of 406 feet! Regarding the grades in this 18.54-mile section, there is only 5,920 feet, or 1.12 miles, which is on the level. If the level lengths in NKW, CLO and KCW stations are excluded, the no-grade interstation lengths have a total figure of only 1,050 feet, or 1/5 mile, in 18.54 miles of the main line! Here also, it might be noted that the other stations; viz., TYN, CYK, SPU and HPT, are on grades of 1 in 50, 30, 33, and 160, respectively.

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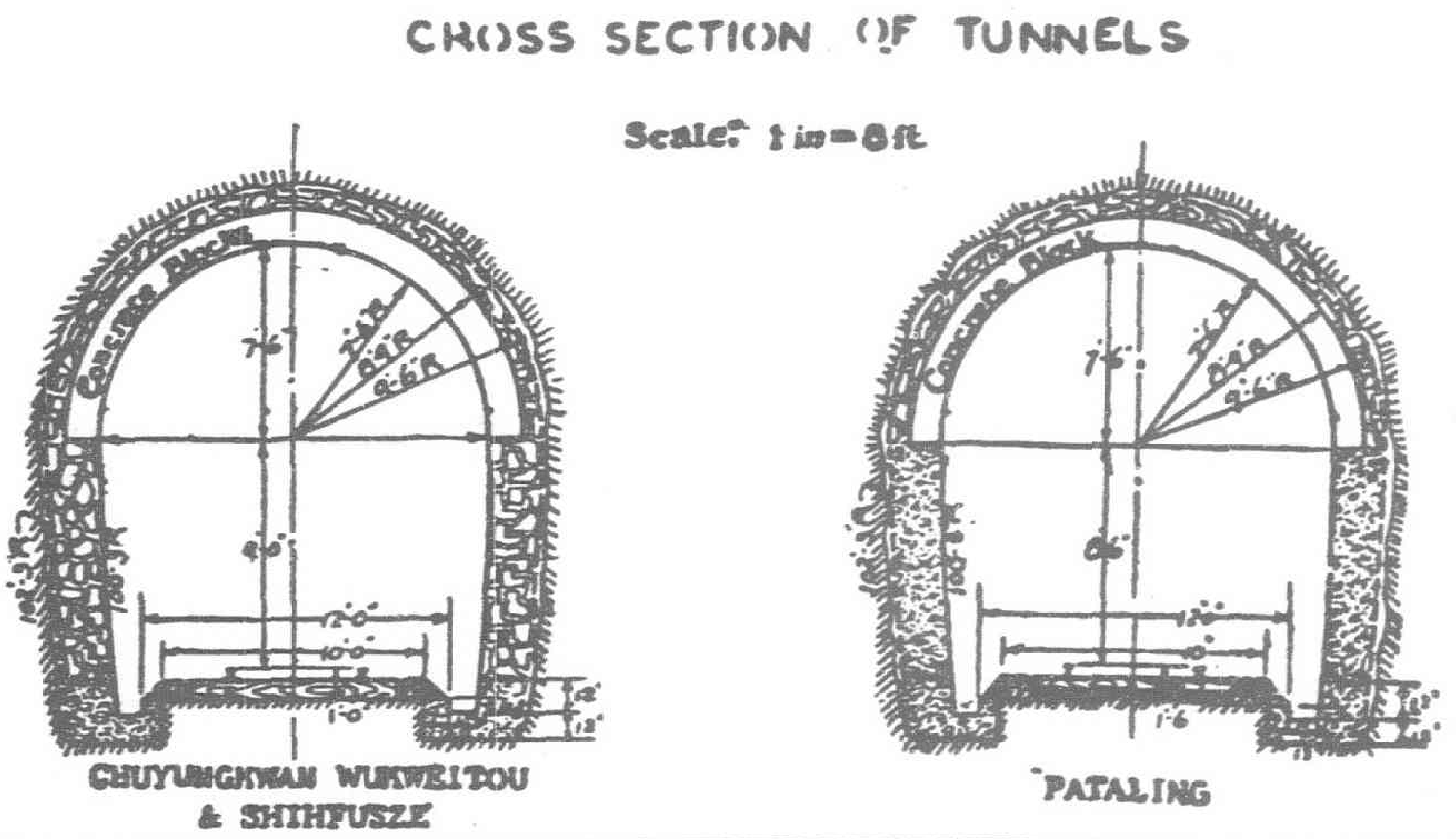
†Elevations mentioned herein are those referring to an arbitrary datum which is itself 121.78 feet above the mean sea-level at Tangku.

The main line, after running up to CLO station, switches back therefrom on ascending grades, while entering the long Pataling tunnel. The line reaches the highest point in the Pass (elevation = 1,959.20-ft.) in the said tunnel, at a distance of one mile from the center of CLO station, and then descends from this summit to KCW.

FIGURE 2



Transition curves, 150 feet long at each end, are used on curves with radii of 800 feet or under.

Track

Rails 30 feet long, 85 pounds per yard, Sandberg section, hardened by the Sandberg sorbitic process, are laid on tieplates throughout the section, strengthened on curves with rail braces, and fastened with dog spikes. The joints are alternate.

Sleepers are of two sizes, 9-in. by 6-in. by 8-ft. and 9-in. by 7-in. by 9-ft. For each rail-length, four pieces of 9-in. by 7-in. by 9-ft. and 12 pieces of 9-in. by 6-in. by 8-ft. are used on the NKW—HPT section, one piece less of the 9-in. by 6-in. by 8-ft. sleeper on the HPT—KCW section. The 9-in. by 7-in. by 9-ft. size is the joint sleeper, two being used at each rail-joint. Treated sleepers were laid in the Pataling tunnel and are still in fairly good condition. When the track was first laid, all the sleepers in the Pass were coated with coal tar, but this practice was discontinued in the renewals of recent years. An extra fishplate (angle bar) is bolted and spiked on the outside of each rail at its mid-length opposite the joint in the other rail. This extra fishplate and the longer sleepers are used with the idea of preventing rail-creeping.

Broken stone is used as track-ballast, the thickness under the sleepers being from 6-in. to 8-in.

Bridges and Culverts

There are no bridges of any considerable size in the Nankow Pass. Those worthwhile to be mentioned are as follows:

(*a*) One open-deck bridge of single span, 100-ft. deck warren-truss, between NKW and TYN.
(*b*) One 40-ft. arch culvert, between TYN and CYK.
(*c*) Three 30-ft. arch culverts, between CYK and SPU.
(*d*) One 40-ft. arch culvert, between CYK and SPU.
(*e*) Five open-deck spans of 30-ft. rolled I-beams, between HPT and KCW.

All the bridges and culverts in the Pass are meant to carry a live load equivalent to Cooper's Class E50. All the arch culverts are of plain concrete.

Tunnels

There are four tunnels in the Nankow Pass, tabulated as below:

TABLE III.

Name of Tunnel	*Between Stations*	*Length in ft.*	*Lining*	*Portals*
Chuyungkwan	TYN & CYK	1,204	Concrete arch Rubble sidewalls	Concrete
Wukweitow	SPU & CLO	150	Concrete arch Rubble sidewalls	Concrete
Shihfusze	SPU & CLO	463	Concrete arch Rubble sidewalls	Ashlar granite back filled with concrete
Pataling	CLO & HPT	3,580	Concrete arch and sidewalls	ditto

The two short tunnels are almost entirely on curves. The Chuyungkwan tunnel has its southern end, 159-ft. long, on a spiral transition curve, while the whole of the Pataling tunnel is on a tangent.

The Chuyungkwan tunnel is on an up-grade of 1 in 30 throughout and both of the two shorter tunnels are situated on an up grade of 1 in $33\frac{1}{3}$. The grades in the Pataling tunnel are analyzed as follows: Starting from the south portal, i.e. CLO side, the first 100-ft. are on up grade of 1 in $33\frac{1}{3}$; the next 450-ft., on up grade of 1 in 100; the following 1,100-ft., on up grade of 1 in 45.45; the remaining 1,930-ft., on down grade of 1 in 500.

There is a shaft 10-ft. in diameter directly over the center line in Pataling tunnel. This was driven during the time of construction, and is now kept open for ventilation purpose.

The cross-sections of the tunnels are shown in Fig. 2. Unfortunately, the small clearance constitutes a great handicap in the operation of trains, especially the very poor ventilation that is found in running steam locomotives through the two long tunnels.

Refuge recesses 7-ft. long by 6-ft. deep by 7-ft. high are provided in the two long tunnels, 4 in Chuyungkwan tunnel spaced at about 200-ft. apart, 11 in Pataling tunnel spaced at about 300-ft. apart.

Stations

The stations NKW and KCW are terminals for operation of all trains running through this section. At both stations, there are engine sheds, water tanks, coaling stages, turntables, classification yards, etc. (The Central Mechanical Works and general stores are also located at NKW). The station CLO, while being equipped for watering engines, serves mainly for reversing the directions of trains, since it is a "switch back" station. It is also a passenger station for tourists who wish to visit the Great Wall of historic interest, on top of the Pataling hills. The remaining four stations TYN, CYK, SPU and HPT serve only for crossing trains and for catching any runaway trains or cars. Fig. 3 shows the track diagrams for these stations.

Crossing of Trains at Small Stations

By glancing at these figures, one will see that track arrangements at stations TYN, CYK, SPU and HPT differ from those found in small crossing stations in other sections of the Peiping-Suiyuan Railway or on any other Chinese Government Line. Take TYN for illustration. An up train (from Kalgan to Peiping) running on down grade must first stop and wait in front of switch A, which is normally set for the catch siding. A down train (Peiping to Kalgan) running on up grade should first stop between the switches A and B, then back into the passing loop and wait there. The up train then gives a long whistle from the locomotive, the switch A is now set for the main line, and the up train then moves on passing the switches A and B; after this, the down train in the loop proceeds through B and A and continues on its journey.

It should be here noted that any up train, whether crossing a down train or not, must first stop in front of A and sound one long whistle from the locomotive before it is permitted to proceed on the main line. Should the driver of the up train for any reason wish to have his train brought into the catch siding, he must give two long whistles. If there is no whistle, it should be understood that the up train or any runaway car is to go into the catch siding, i.e. one long whistle is the only signal for requesting to proceed on the main line.

In the case of crossing trains, before the down train is brought properly to stop in the passing loop, the switch A must never be set for the main line, even if the up train waiting in front of A gives one long whistle.

Catch Sidings

In addition to the catch sidings provided in the stations, there are 7 more catch sidings located outside station limits as shown in Table IV. Each of the 7 sidings is attended day and night by two men, one on each shift, who are carefully selected and especially trained for this purpose. They appear on the Engineering Department Payroll while those working inside station limits are paid by the Traffic Department. The one-long-whistle rule applies also to these intermediate sidings.

Catch siding No. 1 below NKW station had been in existence from the time when Dr. Jeme first built the line. This was taken out in 1926 when track materials were urgently needed elsewhere, and was never reinstalled.

TABLE IV.

Number	*To*		*To*		*Length*	*Max. Grade*	*Min. Grade*
1	CPH	29070′.00	NKW	1576′.10	Taken	out in 1926	
2	NKW	4954.00	TYN	13409.00	4040	−lin 1875	−lin 74.00
3	NKW	15227.40	TYN	3136.50	812	+lin 37.03	−lin 69.44
4	TYN	6027.00	CYK	8833.40	870	+lin 23.41	−lin 34.36
5	CYK	6704.60	SPU	5957.90	676	+lin 25.10	−lin 24.36
6	SPU	7525.10	CLO	5632.00	1446	+lin 31.25	—lin 34.90
7	CLO	1202.10	HPT	18029.00	566	+lin 21.21	−lin 19.20
8	CLO	11874.10	HPT	7357.00	716	+lin 20.82	−lin 76.12
TYN					2640	+lin 16.12	—lin 32.00
CYK					2069	+lin 18.00	−lin 31.25
SPU					858	+lin 10.02	−lin 34.41
HPT					1218	+lin 25.26	−lin 69.82

Note : — Stands for down grade.
+ Stands for up grade.

Signals

In the Nankow Pass, only the stations NKW, HPT and KCW are provided with the usual distant and home semaphore signals, interlocked with the main line switches, the rest of the stations having no fixed signals whatever. As the trains in the Pass are allowed to run at 10 miles an hour only, and as all the employees of Engineering, Locomotive and Traffic Departments, working in this section, are specially trained and particularly cautioned for any carelessness, it is generally considered that fixed signals at intermediate stations are not absolutely necessary, as may so appear to an outsider. Thanks to the faithful and vigilant efforts of the employees, very few serious accidents have happened in the Pass.

Electric Train Staff and Tablets

Trains running in the Pass are under the control of Electric Staff and Tablets, while the whole of the Peiping-Suiyuan Railway including the Suiyuan-Paotow Extension is still working under the Mechanical Link and Tablet System, with the exception of Hsichihmen—Kwanganmen section (at Peiping), which is also under the Electric Staff and Tablet working. *It is partly due to this* Electric control that very few train accidents have taken place in the Pass.

Rolling Stock

When Dr. Jeme first built the Railway, locomotives of the types Shay (6 in all, Nos. 25—30) and British Mallet (4 in all, Nos. 21—24) were used to handle trains in the Pass. The Shay engines are of the obsolete type, and run at very slow speeds. They are practically scrapped now. The British Mallets have a low tractive power which is now found rather inadequate in operation.

Seven bigger Mallet engines (Nos. 94—100) were purchased in 1914, and seven more still bigger Mallets (Nos. 201—207 were added in 1922. These two series of Mallets constitute at present the principal hauling power in operating trains in the Pass. One or two of the British Mallets are still in use, while none of the Shay engines is ever used now.

Fig. 4 shows the sketch diagrams of the said four types of locomotives with wheel spacings, and Table V gives some characteristic information concerning these engines.

Note that Mallet engines 94—100, and 201—207 are confined *to run in the Nankow Pass only, and are not allowed to go beyond* Nankow or Kangchwang, since the tracks and bridges outside this section are too weak for the loading.

Formerly, the passenger and freight cars of the Peiping-Suiyuan Railway were all equipped with air brakes. As a result of repeated civil wars during the last 10 years, most of the PSR cars have been taken away by military authorities to other lines. The few cars that are left behind have lost most of the parts necessary in the use of air brakes, and the Railway, being now in a very bad financial condition, is quite unable to replenish all of them. A few hundred cars belonging to other lines, now remain on PSR, available for its use, but nearly all of the foreign line freight cars are not equipped with air brakes. Consequently, while all the passenger cars have air brakes, nearly all of the freight cars have none.

The freight cars now circulating on PSR have capacities ranging from 40 long tons down to 10 long tons, and there are only about 500 freight cars of various sizes (and 60 passenger cars) on the whole of the PSR and its Paotow extension with a total main line mileage of 506, and a total branch line mileage of 37 !

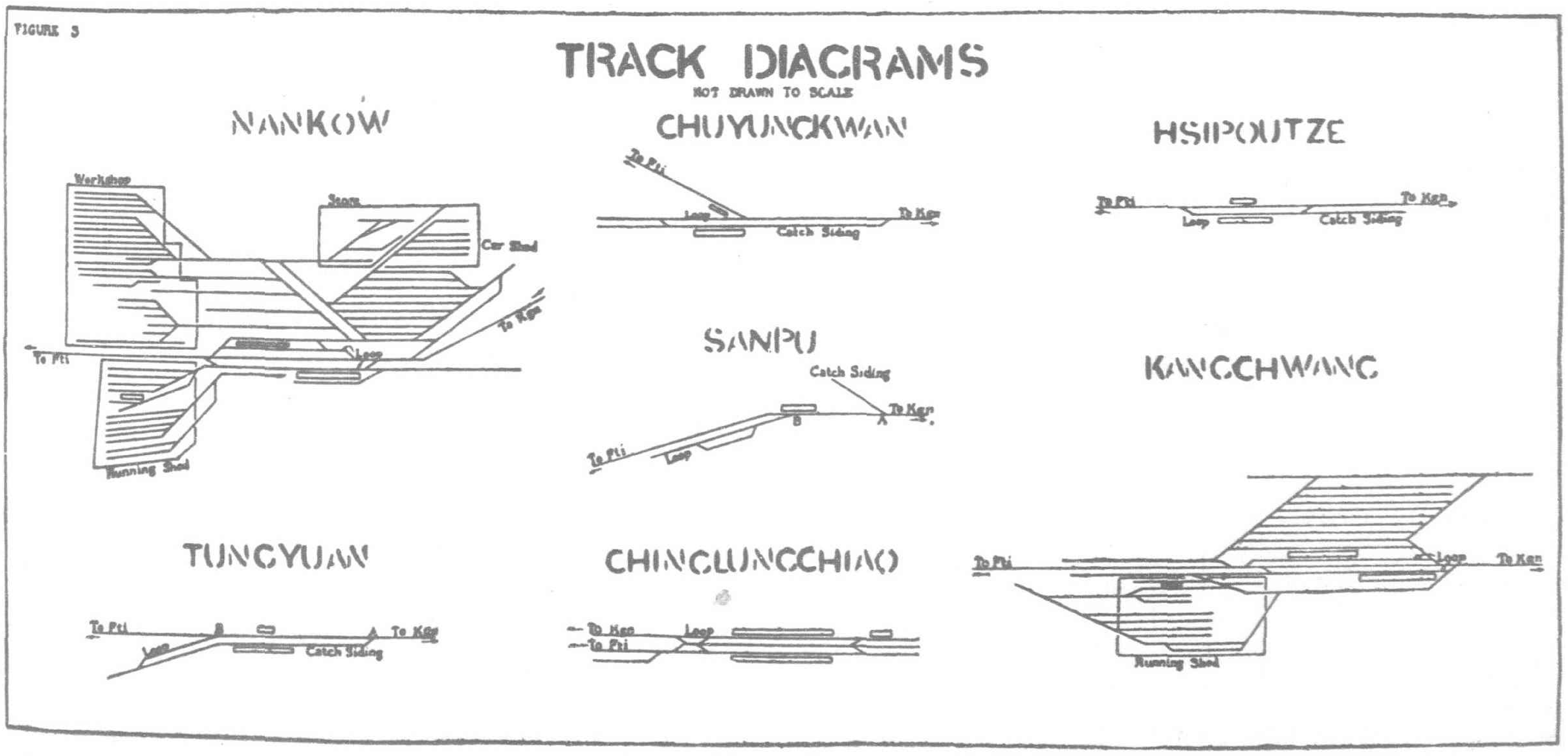


FIGURE 3

TRACK DIAGRAMS

NOT DRAWN TO SCALE

TABLE V.

Type of Locomotives	*Shay*	*British Mallet*	*Mallet*	*Mallet*
Wheel Arrangement	0-4-4-0	0-6-6-0	2-8-8-2	2-8-8-2
Road Nos.	25-30	21-24	94-100	201-207
Date of Adoption	1909	1908	1914	1922
Diameter of driving wheels, inches ..	40	51	50	50
,, ,, leading ,, ,, ..	—	—	30	30
,, ,, trailing ,, ,, ..	—	—	30	30
,, ,, tender ,, ,, ..	—	—	33	33
Cylinders, diameter inches	15	HP 18 LP 28	HP 20 LP 32	HP 24 LP 38
Cylinders, stroke inches	17	28	26	28
Boiler pressure, lbs. per sq. in. ..	200	200	200	220
Fire grate area. sq. ft.	38.8	45.1	59.6	95
Heating surface, total, sq. ft. ..	1904	2591	2626	5538
Heating surface, superheater, sq. ft...	—	—	565	1433
Weight in working order, long tons—				
Leading	—	—	10.9	12.72
Driving	78.69	96.5	106.5	173.43
Trailing	—	—	12	12.94
Engine	78.69	96.5	129.4	199.09
Tender	30.49	40.9	55.8	86.02
Tender Capacity—				
Water, U. S. gallons	3266	4000	6000	10000
Coal, tons	6.5	5.5	10	16
Maximum Tractive Power, lbs. ..	44115	46407	54357	92500

Train Operation and Difficulties

A down train from Peiping, on arrival at NKW, is generally decomposed into portions, and a Mallet locomotive is attached to the rear of each portion, pushing it up from behind as far as CLO where the direction of the train is reversed. From there on, the engine pulls the same portion up into the Pataling Tunnel and then down to KCW, where the several portions are recomposed, and an ordinary road engine is used to pull the train on to Kalgan or beyond.

An up train from Kalgan or beyond, on arrival at KCW, is likewise decomposed into portions, and a Mallet engine is attached to the front of each portion, pulling it to CLO. Here the direction of the train is reversed, and the engine is attached to the other end of the train, pulling it down to NKW, where the portions are recomposed, and an ordinary road engine is used to pull it on to Peiping or Fengtai.

Note that in pulling a down train from CLO station into the Pataling tunnel, running on steep up grades, there is a possibility of some car or cars being detached from behind, due to a broken coupling. Such runaway cars would run into the catch siding No. 7, located between CLO station and the tunnel, instead of running into the station. In pulling an up train from KCW to Pataling tunnel, on up grades, there is the same possibility, but the grades are comparatively more flat than on the other side of the tunnel, and moreover, the catch siding No. 8 and that in HPT station will catch any runaway car or cars.

TABLE VI.

Permissible Speed, 10 miles per hour		*Loco. Nos. 21-24*	*Loco. Nos. 94-100*	*Loco. Nos. 201-207*
NKW to KCW	Train with air- and hand-brakes complete	100 long tons	200 long tons	260 long tons
	Train without air- brakes but with hand-brakes complete	100 long tons	180 long tons	230 long tons
	Train without air- and hand-brakes	80 long tons	140 long tons	200 long tons
KCW to NKW	Train with air- and hand-brakes complete	100 long tons	300 long tons	400 long tons
	Train without air-brakes but with hand-brakes complete	100 long tons	225 long tons	350 long tons
	Train without air- and hand-brakes	80 long tons	100 long tons	120 long tons

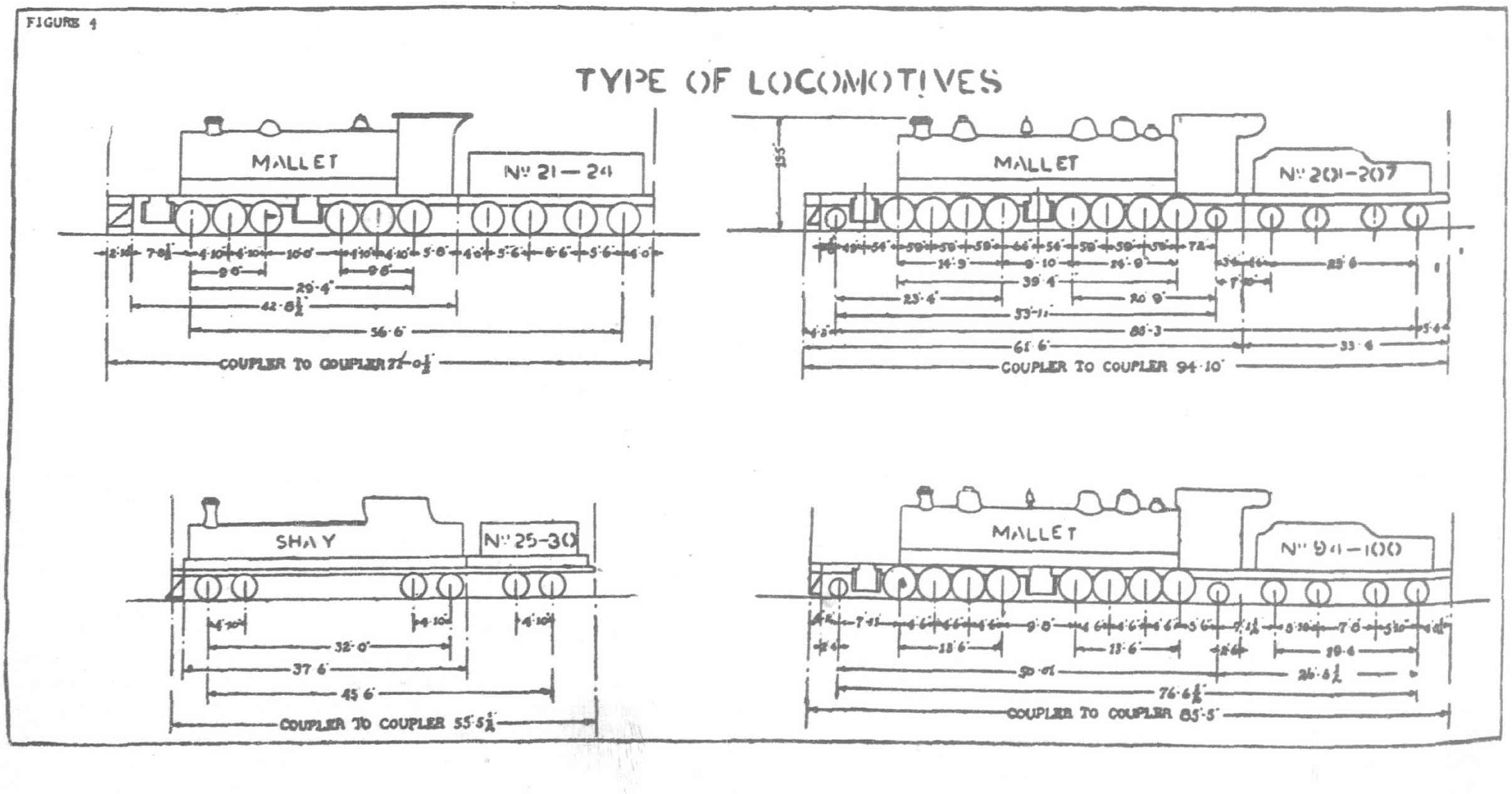
Table VI shows the tonnages that can be safely hauled by the three classes of Mallet engines running in the Pass. Note that there is considerable decrease in tonnages when the cars making up the train have no brakes of any kind.

The tonnages are diminished by 10 per cent. in winter months from November 21 to March 20.

Owing to the fact that most, if not all, of the freight cars now on PSR have no air-brakes, and a large number of foreign line cars have lost some parts of their hand-brakes, the hauling capacities of the locomotives are very much reduced. An engine of the 94—100 series very often hauls down the pass a train consisting of only one loaded 40-ton car and a guard van, and another of the 201—207 series pulls a loaded train composed of only two 40-ton cars and a guard van!

It can then be seen that a loaded train of 600 or 700 tons from Kalgan, has to be divided into five or six portions, and hauled down to NKW successively as five or six separate trains. This not only increases unduly the operating expenses, but the cars are also used in a very uneconomical way, as they are usually held up at the stations NKW and KCW, waiting for despatch and choking up the yard tracks there.

FIGURE 4



TYPE OF LOCOMOTIVES

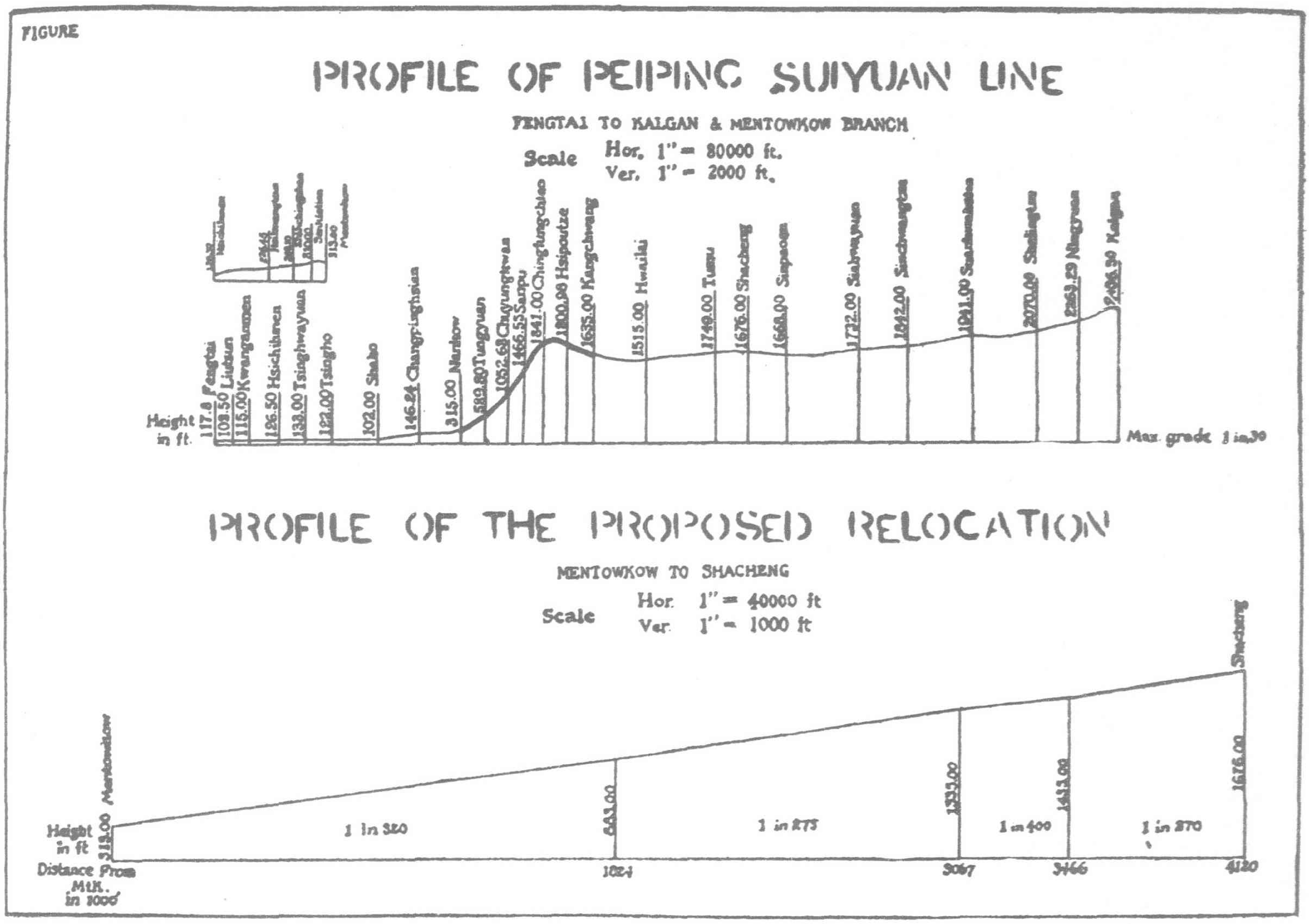


TABLE VIII.

Section	Locos.	Cars with or without Hand brakes	No. of Round trips Train Crew makes per day	No. of 40 ton loaded cars attached to a train	Cost of Train Operation per ton-mile	Com-parative Ratio
'atung o Kang-hwang	Mikado Series	—	—	13	$ 0.000895	1.0
Kangchwang to Nangkow	Nos. 94—100	Without hand-brakes	One trip per day	1	0.0343	38.3
				2	0.0172	19.2
			Two trips per day	1	0.0255	28.5
				2	0.0128	14.2
		With hand-brakes	One trip per day	2	0.0172	19.2
				3	0.0114	12.7
			Two trips per day	2	0.0128	14.2
				3	0.0085	9.5
	Nos. 201-207	Without hand-brakes	One trip per day	1	0.0386	43.2
				2	0.0193	21.6
			Two trips per day	1	0.0299	33.4
				2	0.0050	16.7
		With hand-brakes	One trip per day	5	0.0077	8.6
				6	0.0064	7.1
			Two trips per day	5	0.0060	6.7
				6	0.0050	5.6

At present, there are only about 8 to 12 trains both ways running daily on PSR other than the Nankow Pass, yet the number of trains running in the Pass, both ways, is already 44 to 56 per day, which is almost up to the full capacity of a single track railway. If, in the future, Railways are extended into the Provinces, Kansu and Sinkiang (Chinese Turkestan), and possibly into Outer Mongolia, too, resulting in the development of resources in the Northwest, the PSR would serve as a main artery for the traffic to and from the sea coast. The present capacity of the Railway through the Nankow Pass would then be far from equal to such a traffic demand.

Cost of Operation

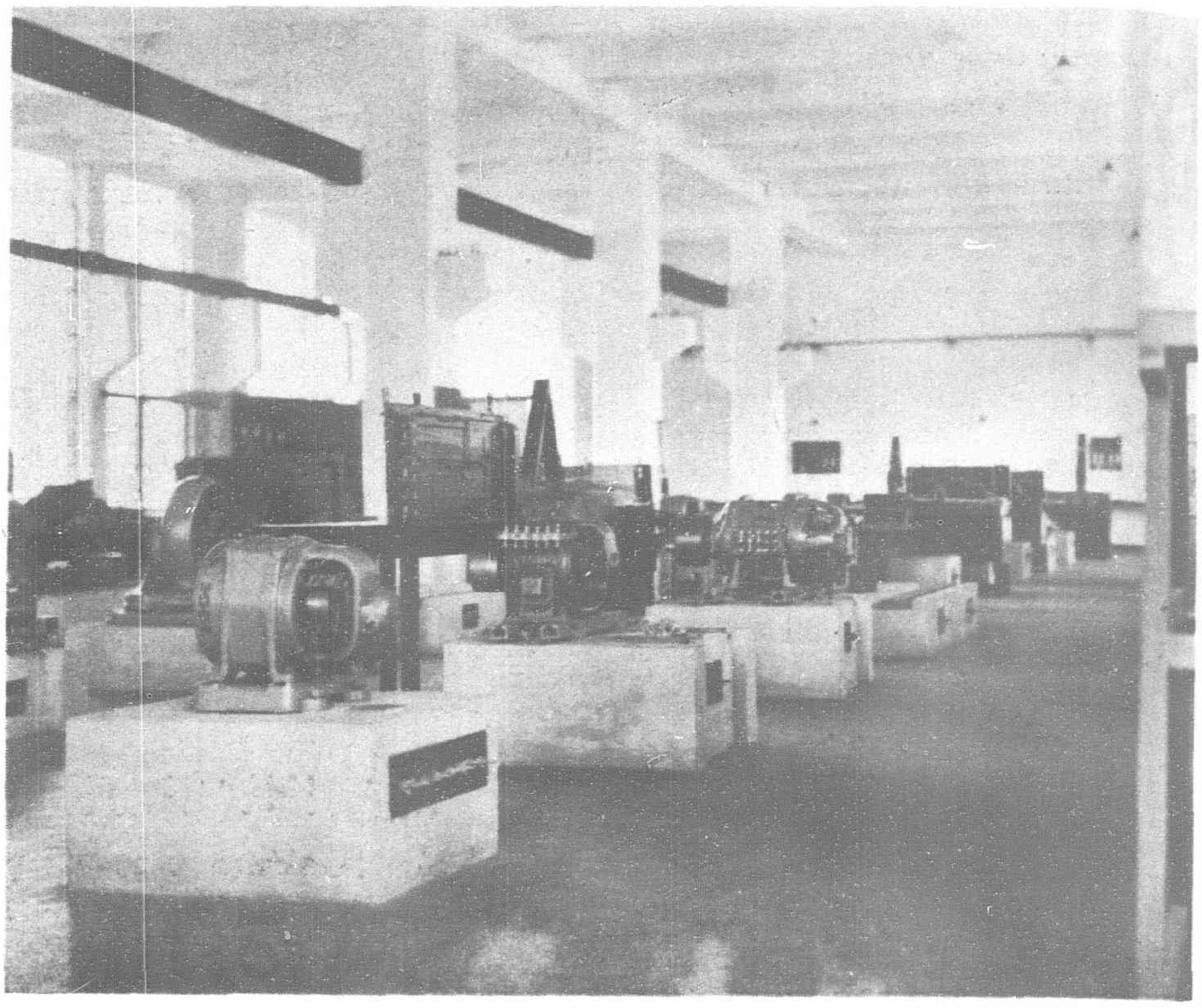
For the sake of simplicity, we will consider only the actual operating expenses necessary in running the trains, disregarding the interest on capital cost, overhead expenses, depreciation and maintenance charges on fixed structures and rolling stock, expenses at stations, etc. Based upon data available at hand, Table VII has been prepared, showing the approximate costs of transporting one ton of coal per mile between Tatung (185.39 miles west of Kangchwang) and Kangchwang which is comparatively flat, and between Kangchwang and Nankow which is quite hilly as heretofore described.

Proposed Measures for Improvement

Not a few men now think it a great mistake on the part of the engineer who built the Peking-Kalgan Railway to have adopted the route through the Nankow Pass. In order to be fair to Dr. Jeme, we should bear in mind the fact that he was allowed at the outset a construction fund of only four or five million taels to build the whole of the Peking-Kalgan line in a specified time of three or four years. We are told that he did take other alternative routes into consideration, but as such routes would have required longer time and more money to be completed, he decided to adopt the

(Continued on page 479)

Chiaotung University Where China's Young Engineers are being Trained*

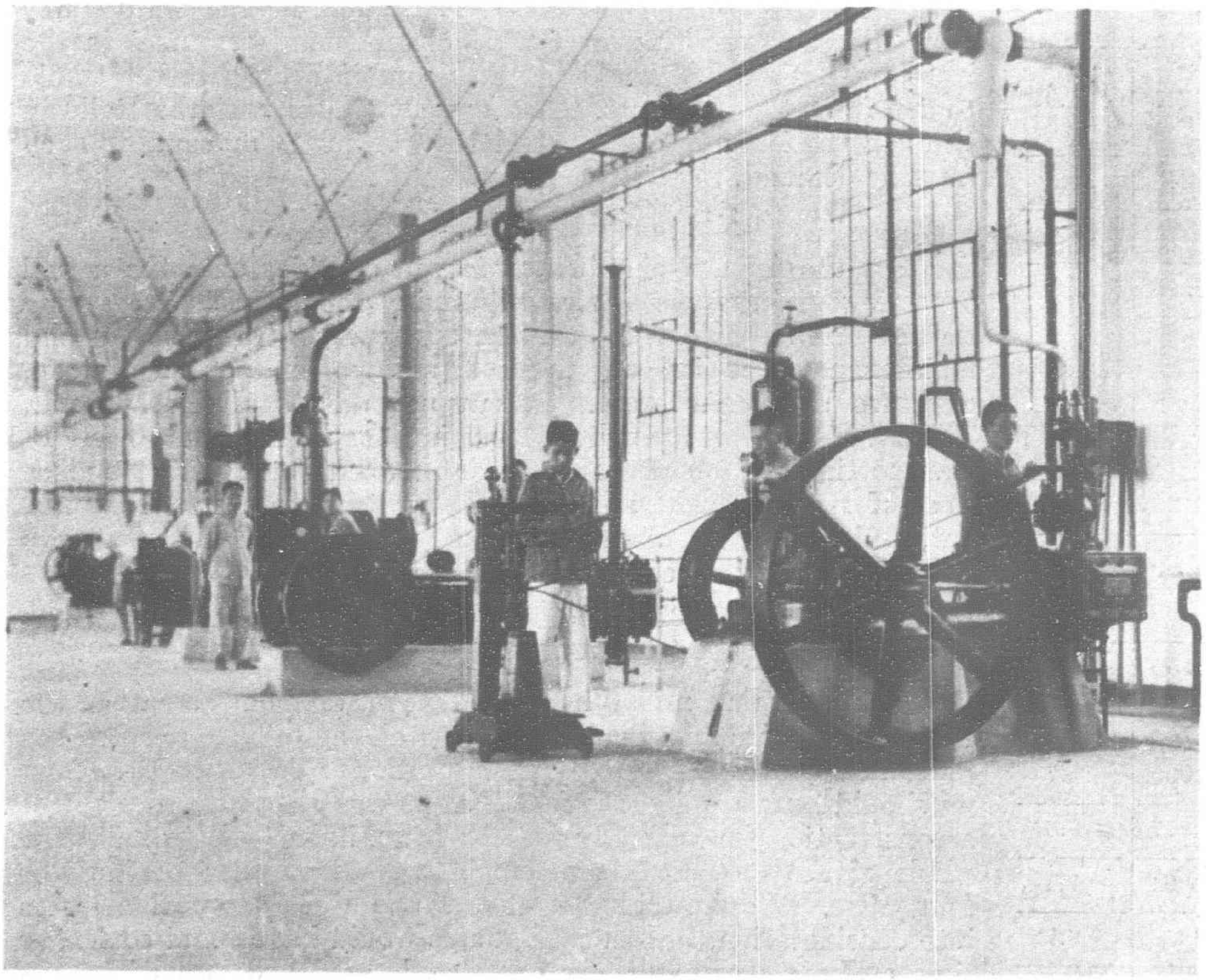


General view of Dynamoes in the Electrical Laboratory at Chiaotung University

DESPITE the discouraging fact that hundreds of returned students—qualified engineers and technical men—become gold bar brokers, teachers and engage in business entirely different in line from that for which they have been trained, there still remains a colony in China where hope is ever entertained by many for opportunities offered in the execution of the plans for the reconstruction and industrialization of China.

The colony, in which about 250 youths come and go yearly and where there are more than 1,000 residents, is the Chiaotung University which is composed of five sub-organizations: the three Nanyang Colleges at Shanghai, the Peking School at Peking and the Tangshan College at Tangshan. The three Nanyang Colleges are the College of Science, the College of Administration, and the College of Engineering which comprises the Schools of Civil Engineering, Mechanical Engineering and Electrical Engineering. The Peking School is devoted to the teaching of railway administration, and the Tangshan College to mining and civil engineering.

Chiaotung University is the outgrowth of the former Nanyang College sponsored 38 years ago by Mr. Shen Hsuan-wei, the then managing director of the China Merchants' Steam Navigation Company and the Imperial Chinese Telegraph Administration. and established by a Government order. The campus of the three Nanyang Colleges (popularly called the Chiaotung University) at Siccawei covers an area of 250 mow (approximately 42 acres). The University is a Chinese National Government institution directly under the control of the Ministry of Railways.



Students at work in Laboratory

The Engineering Building

Through the efforts of the directors and presidents and the support of the Government and friends. the University has acquired many improvements of which the construction of an engineering building, different laboratories and work shops for the practice and training of the students is a unique feature. The University also maintains a research institute with branches at Tangshan and Peking in which research, experiment and commercial testing work are executed.

Built at a cost of more than $300,000, the engineering building occupies a ground area of 21,000 square feet and is one of the most up-to-date buildings of its kind in China. There are in this building various class-rooms, drafting-rooms, projection rooms, staff rooms on the top floor, in addition to the following; main mechanical engineering laboratory, hydraulic laboratory, internal combustion engineering laboratory, automobile engineering laboratory, fuel and oil testing laboratory, sanitary testing laboratory, material testing laboratory, main electrical engineering laboratory, electric testing room and electrical standardization room.

Attached to the rear of the building, which is of reinforced concrete and fitted with huge glass windows all around the two stories, is a boiler house. The equipment in the house consists of, besides a superheater, a “ Babcock and Wilcox ” 40 horse-power cross drum water tube boiler, an “ Ames ” 70 horse-power return tubular boiler and a dismantled “ Farnham ” locomotive-type boiler. There are also a 5-in. by 3-in. by 8-in. “ Hill ” boiler feed pump, and a 3-in. by 4-in. “ Smith-Vaile ” duplex boiler feed pump. Two graduated 4-ft. by 9-ft. steel tanks afford means of measuring the boiler supply water, and an injector serves as a standby in case of failure of the feed pump.

The Laboratories

Complete with extensive equipment, the different laboratories maintained by the University for experiment and testing work by the students are of great advantage and value. A brief description of some of the laboratories and the equipment will

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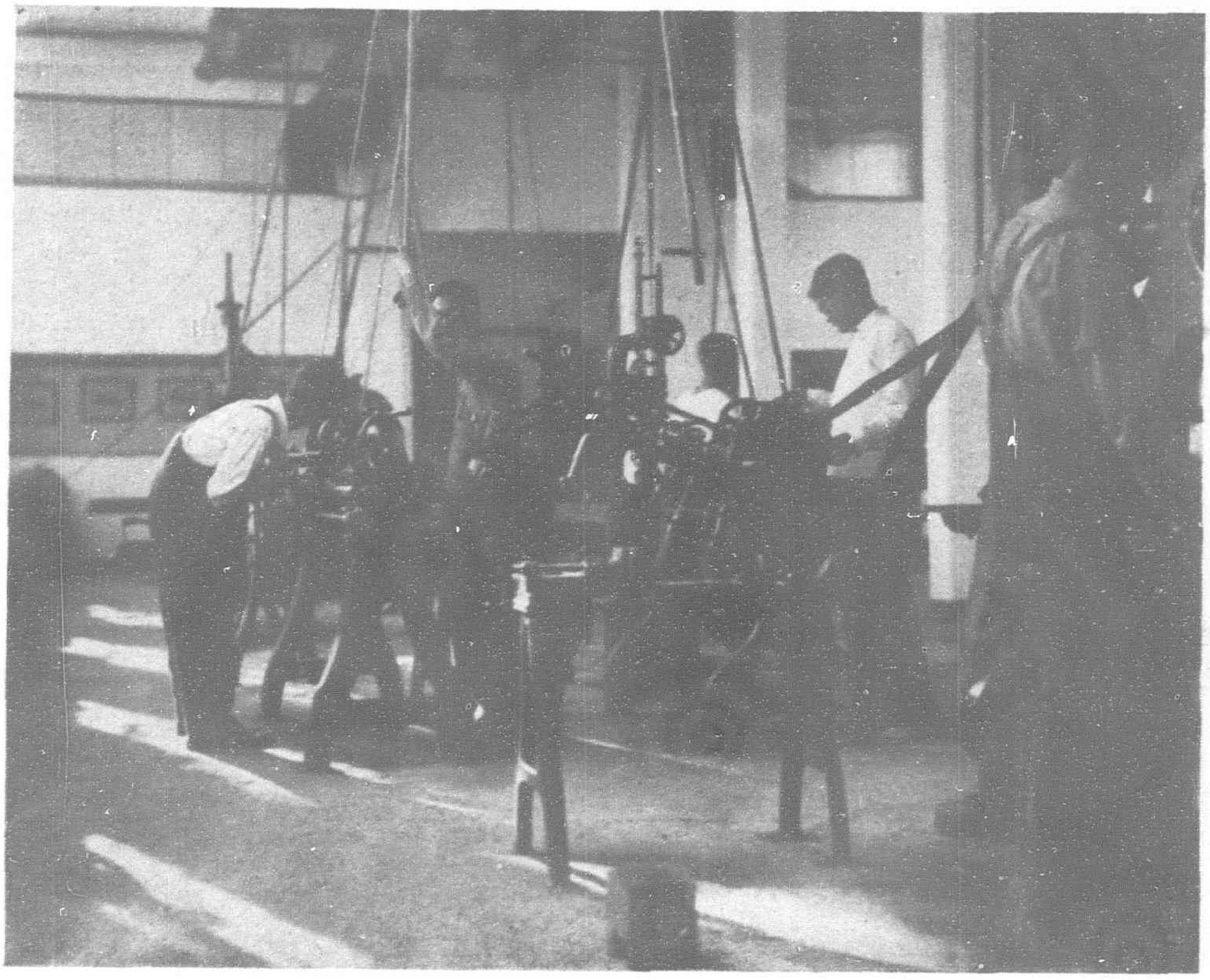
The North-China Daily News



Students at work

give a general idea of the extent of work done in the three Nanyang Colleges.

In the Material Testing Laboratory, the equipment consists of the following apparatus ; one Universal testing machine of 100,000 lbs. capacity for making tension, compression, shear and bending tests on various materials, one of 30,000 lbs. capacity ; one of 20,000 lbs. capacity ; one hydraulic power testing machine of 65,000 lbs. capacity ; apparatus for measuring deflections of beams, elasticity and elongation of metal bars; complete apparatus for testing cements, mortars, bricks, reinforced concrete beams, etc.

The equipment in the Highway Testing Laboratory consists of one Diamond Drill, one Page impact machine ; one Devel abrasion machine ; one Ball grinding mill ; one Dorry's hardness testing machine ; one Briquette moulding machine ; one Diamond Saw and Grinding Lap ; one Asphalt testing machine, one cementation testing machine ; etc.

This equipment is not only used by students for experiments but also provides facilities to carry out research and for commercial testings. With a view to making this laboratory more serviceable to the public, the University authorities are to instal one testing machine of 600,000 lbs. capacity and some additional testing machines for impact, torsion, rock crushers, brick rattler and apparatus for testing weaving products, etc.

The Material Testing Laboratory has conducted many tests for the different Government railways, engineering institutes, the National Economic Council, various works, factories, local and provincial authorities.

The Civil Engineering School also plans to instal a complete hydraulic laboratory to replace the existing hydraulic testing equipment. It is expected that in a not distant future, the Material Testing Laboratory will be in a position to meet the increasing demands of the community in a more efficient way.

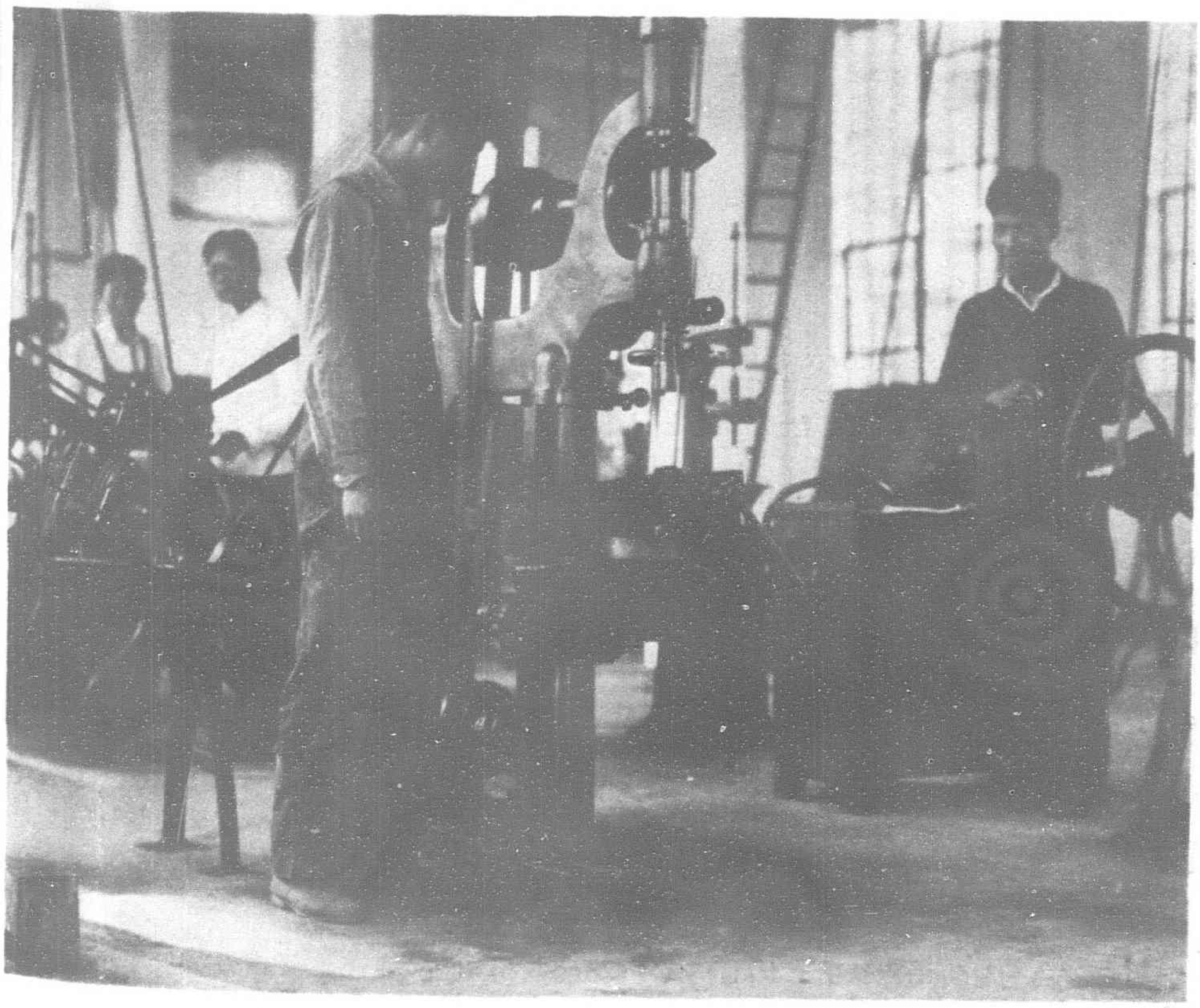
Mechanical Engineering

In the Main Mechanical Engineering Laboratory, the equipment consists of a 25 kw. Curtis steam turbo-generator set. The Curtis turbine is arranged for either non-condensing or condensing operation. The condensing equipment is a Worthington 166 sq. ft. surface condenser in connection with a 4½-in. by 5½-in. by 5½-in. by 6-in. Blake Knowles pump. Connected to the same condenser is an 8-in. by 8½-in. by 9-in. Worthington steam-driven feather valve air compressor of 170 cu. ft. capacity, at 100 pounds pressure, with air tank arranged for testing. A 500 watt steam turbine with locomotive headlight is fixed on the wall for testing. There are two horizontal steam engines : one is a 7-in. by 10-in. Leffel engine fitted with a Rites flywheel governor and the other is a 9-in. by 12-in. Marshall engine fitted with a spring throttling governor. These engines are furnished with lubricators, separators, steam calorimeter, indicator connections, and prony brakes with platform scales.

There are five types of hoisting appliances of different lifting capacities placed in this laboratory all arranged for making tests.

An engine testing section and a section for the display and demonstration of automobiles, motor trucks, and their component parts from the Automobile Laboratory. In the display and demonstration section are gathered together a 4-cylinder Hudson pheaton, dismantled chassis of a 4-cylinder Allen car, various types of engines, transmissions, rear axles, differentials, clutches, carburettors, ignition systems, and other automobile parts and equipment. A pit is specially built for examining and fitting engine parts from under the chassis of an automobile. Working bench, Vicker garage jack, parts rack, etc., are also provided.

The Fuel and Oil Testing Laboratory is equipped with apparatus for making all the standard tests of fuels and oils. The more important apparatus include calorimeters, viccos meters, flash and burning test apparatus, together with the necessary hydrometers, thermometers and chemical balances.



Students at work in Machine Room

The Wood Working Shop

The Wood Working Shop contains the necessary bench tools and wood working machines required to give the student experience in the use of both hand and power woodworking tools in joinery and turning. The direct object of this training is the proper preparation of patterns for the foundry work, which branch is presented to the student in the first year. The wood work is conducted in a one storey brick building 33-ft. by 128-ft. All the power machines installed in the shop are all electric motor group driven from a ten horse-power and a fifteen horse-power General Electric induction motor.

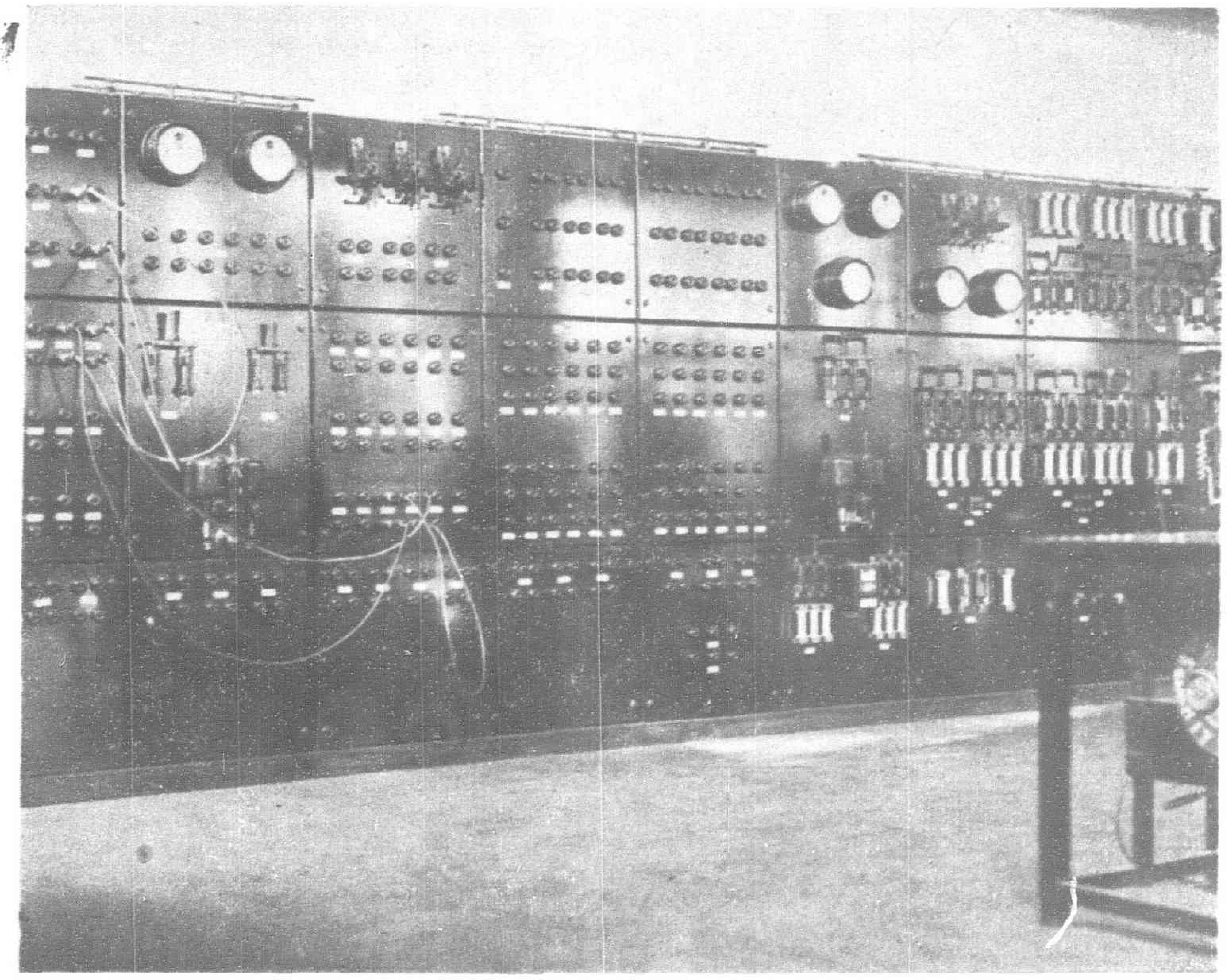
The Machine Shop occupies an area of 8,180 sq. ft. It is divided into two sections, in one of which are machine tools group driven by electric motors and in the other are benches and machine tools individually driven by electric motors.

The equipment includes principally the following: twelve lathes, two shapers, three drilling machines, one planer, one milling machine, two milling cutter grinding machines, and one power hacksaw. There are also a considerable number of small tools, such as dies, taps, reamers, surface sugages, etc.

Of particular interest to the students pursuing the course in electrical engineering is the electrical engineering section in the main Engineering Building. The section occupies two stories with a combined area of 17,200 sq. ft. The ground floor contains the University substation, including the service switch-board, standardization and measurements laboratory, direct current dynamo laboratory, alternating current dynamo laboratory, high tension laboratory, electric railway motor testing laboratory. The electrical laboratory obtains alternating current from the mains of the Shanghai Power Company. The alternating current is transformed in the substation near the University to 4 wire, 3-phase, 350-volts from the mains and 200-volts to neutral.

The first floor contains the illumination and photometric laboratory, four lecture rooms, one large electric machine design room, and three office rooms of the College of Electrical Engineering.

There are in this section electric railway testing equipments; television equipment; automatic telephone switch-board; machinery and apparatus necessary for the experimental study of single phase and poly-phase circuits and the generators, motors and other appliances used on those circuits; D.C. and A.C. switch-boards; and machines covering the range of motor and generator testing done in modern electrical laboratories.



Switch-board in the Electrical Laboratory

Through the generosity of various American companies, the transformer equipment is very complete including two 5 kva. three-phase transformers and eighteen other transformers up to 7½ kva. in capacity and of many different types.

For the work in telegraphy, an assortment of keys of different types, transmitters, simple, polarized and differential relays, repeaters, together with the necessary rheostats, condensers, etc., for setting up complete lines of various types, will provide for the study of the simplex, duplex and quadruple systems as used in modern telegraph.

For the study of submarine telegraphy, an artificial cable will be provided with the various types of transmitters and recorders and auxiliary apparatus used in cable work, allowing for practice in adjusting, testing and operating of cable sets. The work in the laboratory is supplemented by inspection trips to the cable stations in town.

There are also necessary facilities for laboratory and research work in radio telegraphy and telephony.

The Physics Laboratory

Located on the second floor of the College Building is the Physics Laboratory. It is fully equipped with water and gas facilities as well as D.C. and A.C. supplies. A sufficient number of desks is provided for 24 groups of students (two to three students in each group) working at the same time.

Adjacent to the laboratory is an apparatus room equipped with instruments for lecture demonstration and for students' exercises. Among the former class of equipment might be mentioned the wireless apparatus, and the apparatus for demonstrating the properties of Cathode rays, and X-rays. The equipment of the second class is provided primarily for familiarizing the students with the significance of important physical laws, as well as the methods of technical measurement.

The Chemistry Laboratory

The Chemistry Department is provided with two laboratories, one for general chemistry and the other for chemical analysis, on the ground and first floors respectively of the Preparatory Hall Each has a floor space of about 1,500 sq. ft. and is properly equipped with gas, water, sinks, ventilators, and other facilities. The laboratories now accommodate 80 students from the Preparatory School and 150 freshmen and 150 sophomore students from the Engineering and Science Colleges.

For the laboratory work in Preparatory and General Chemistry, the Department keeps a sufficient stock of the necessary apparatus for performing all the experiments, as given in laboratory outline of Smith's Intermediate Chemistry by Kendall and Exercises in General Chemistry by Deming and Arenson, Provision is also made for carrying out certain physico-chemical experiments such as molecular weight determination, vacuum distillation, and Hion determination both by indicators and by quinhydrone electrode.

For chemical analysis, full equipment is available for the qualitative and quantitative determination of simple minerals and industrial products. In addition, there are special apparatus for technical analysis, such as Braun sample grinders, Maker burners, Thelco-electric ovens and Hoskin's muffle furnace for coal analysis, Hempels and Hay's apparatus for gas analysis. Penetrometers, viscosimeters and ring and ball apparatus for testing bituminous road materials. Saybolt and Scott viscosimeters, Cleveland and Pensky-Marten flash-point testers, A.S.T.M. cold test apparatus, Conradson coal residue apparatus, Abbe refractometers, Lovibond tintometer, Gardner mobilometer, distillation and steam emulsion apparatus, hand and electric centrifuges and Sharples super centrifuge for the examination of oils, paints, and lubricants.

Professors and Graduates

The University has in its employ over 100 persons in the administrative and business staff and 210 in the teaching and research staff.

Although the primary object of the University is to train students for the specific needs of the Ministry of Railways under whose support and control the University exists, yet the curricula

(*Continued on page 479*)

Manufacture of Submarine Telegraph and Telephone Cables in Japan

By Dr. S. BEKKU, Works Manager, Sumitomo Electric Wire and Cable Works, Ltd.

(1) *Present Status of Submarine Cable Manufacture.*

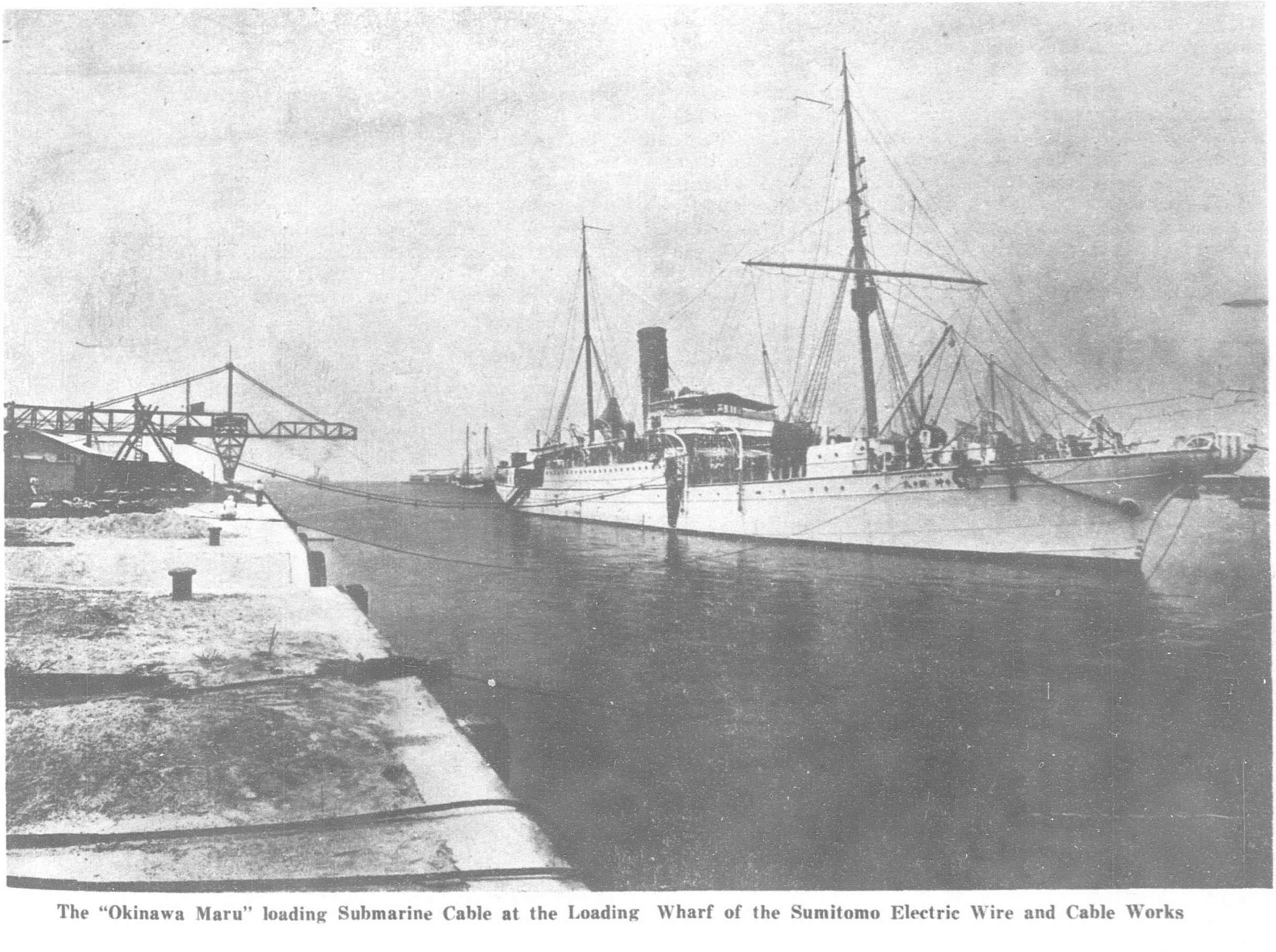
It is not difficult to conceive that the fact of bridging the English Channel with a submarine telegraph cable in 1851, effecting direct communication between England and the Continent, was considered as one of the startling events of that time. After the invention of the gutta percha extruding machine by Werner Siemens in 1847, just a few years prior to this great event, the manufacture of gutta percha insulated submarine telegraph cables pronouncedly assumed a modern color. We find that over 2,000 nautical miles of this type of cable was laid between Ireland and New Foundland in 1858. When this great task of connecting America and England with electricity was accomplished it is quite comprehensible that those who shared the responsibilities became ecstatic over this achievement.

Unceasing development and progress of the industry since this time has given the world a complete network of such cables, totalling at present an enormous length. A considerable advance in the electrical characteristic of the submarine cable had been made by the application of balata. With the invention of paragutta, the industry entered a new epoch and telephone communication through submarine cables was made possible across the Atlantic Ocean and had it not been for the present world economic depression, there would have been constructed a submarine telephone cable, connecting the United States with Europe.

In view of such development in the West, and also of the fact that Japan is bounded by water on every side, there is much to regret with respect to the development of this industry in Japan. The general electrical industries have made rapid progress so that almost any electrical equipment for installation on land can be found among domestic manufactures. In spite of this fact, the great length of submarine telegraph cables linking satellite islands with main islands which the Department of Communications now own and operate, with the exception of a very small part of special lead covered paper insulated submarine cables, are of foreign manufacture. The result of this regrettable condition can be traced to the cause, that is, that due to the absence of local manufacturers, Japan had been made a dumping market by foreign manufacturers.

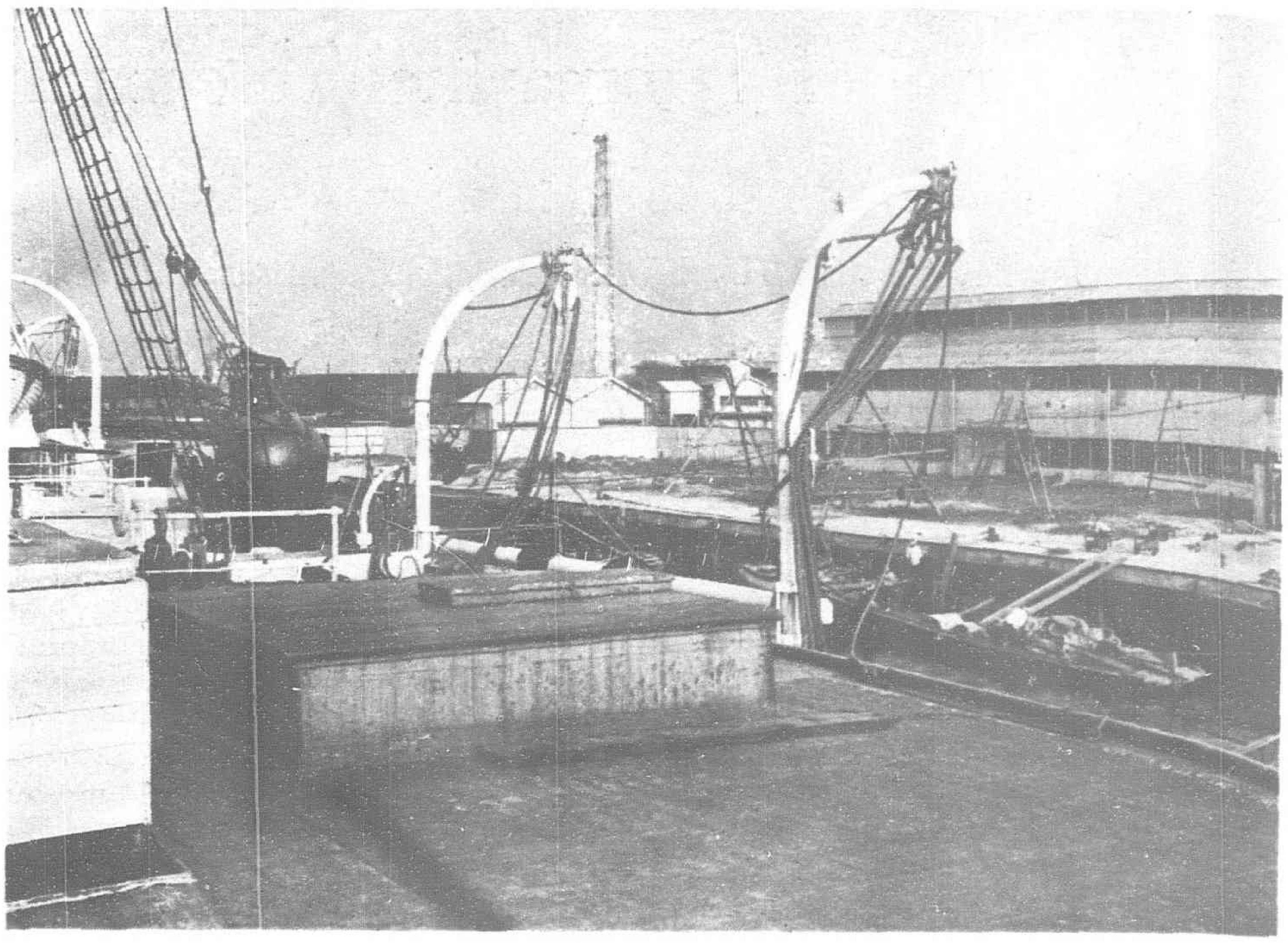
Messrs. Sumitomo Electric Wire and Cable Works, Ltd., made a complete study in 1921 of the subject of submarine cable enterprises, and instructions were issued by the Department of Communications to the Company on August 11, 1931, for prompt action in the establishment of a factory in accordance with a submitted plan. The Company, therefore, took immediate action for erection of the factory.

The autumn of 1931 was marked by unusually heavy rain and hence the progress of the foundation works and the river bank revetment works was greatly hindered and frequently lagged behind schedule. Only with the extraordinary efforts of those concerned, the plant was completed and the manufacturing of the gutta percha



The "Okinawa Maru" loading Submarine Cable at the Loading Wharf of the Sumitomo Electric Wire and Cable Works submarine cable was ready to be commenced by the middle of February, 1932, as scheduled.

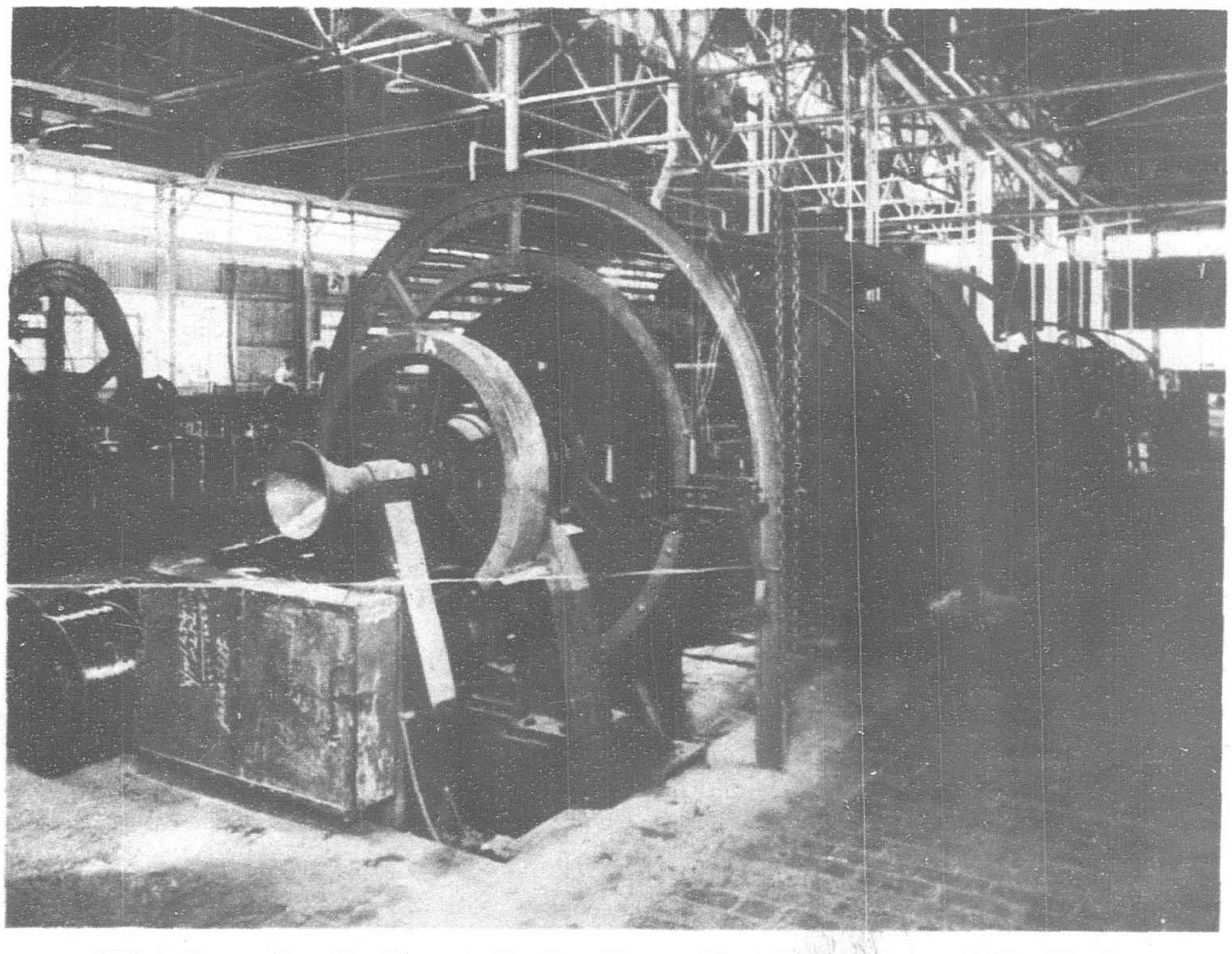
Incidentally, at this time, the District Government of Taiwan (Formosa) decided to purchase seven nautical miles of an intermediate cable for the repair of a submarine telegraph cable in the vicinity of Hoko-to Island (Pescadores Islands to the West of Formosa). The Company successfully competed with foreign manufacturers and received this order. As the laboratory research was then completed, the actual manufacturing was started on March 1, and without much delay this first job was successfully completed. An engineer of the Electro-technical Laboratory of the Department of Communications came to Osaka as Inspector of the plant as well as inspector of this first cable. After making an exhaustive test, the cable was approved and shipped to Nagasaki and supplied into the cable tank of the Department of Communications on March 23.



A part of the Sumitomo Submarine Cable Works seen from the Deck of a Cable Ship

As the result of the plant inspection and the tests of the cable manufactured, the Company was designated as approved manufacturers of submarine telegraph cables and was so recorded in the specifications of the Department of Communications. When the Department began purchasing submarine telegraph cables, the supply was monopolized by foreign producers for many decades, but the cherished desire of many years to produce a competitive product of domestic manufacture was at last realized, and it is the greatest honor for the Sumitomo Electric Wire and Cable Works, Ltd., to have become the sole approved manufacturer in Japan. It can be considered also, as a happy event for the nation to become independent in the manufacture of submarine cables.

The natural course following the problem of telegraph submarine cable manufacture is that of telephone cable manufacture. Although there are far greater technical difficulties involved in telephone cable manufacture as compared with that of telegraph cables, the Company undertook at once a trial manufacture of three nautical miles of 4-core, duplex, submarine telephone, shore-end cable and submitted it to the Department of Communications for official approval. The Government decided to make a complete test after the cable was actually laid in the usual manner and therefore placed with the Company an order for 4-core telephone cables which were to be laid across the Bay of Tokyo.



Wire Armoring Machine at the Sumitomo Electric Wire and Cable Works

Having received the instructions and the order, the Company manufactured, besides the three nautical miles of shore-end cable as previously mentioned, six nautical miles of shore-end cable together with one nautical mile of a double armored, special shore-end cable. When the cables were completed, preliminary tests were made by an engineer sent from the Electro-technical Laboratory. When the tests were finished, the Department of Communications cable ship, *Okinawa Maru*, was sent to Osaka and for the first time, a cable ship moored at the loading wharf of the factory on July 14. The loading of 10 nautical miles of cable was finished on the 15th, and early on the next morning, the vessel sailed for Yokohama. The cable was laid on the 20th across the Bay of Tokyo as previously arranged. The tests were finished on the 24th with complete success.

As the result of this the Company was appointed approved makers of submarine telephone cables. Due to the present condition in the current exchange, the Company was successful in getting an order of 57 nautical miles of submarine telephone cable for Chosen Straits. The cable was completed in January, tested and was laid across Chosen Straits in April. Aside from this order, the Company has received several telegraph cable orders which amount to several hundred nautical miles for maintenance of existing submarine telegraph network. A portion of these cables is also completed but the factory will be busy for a while with the remaining orders.

(2) *Distinctive Features of the Plant Equipment and Test Records of Sumitomo Submarine Cables.*

Sumitomo Submarine Cable Works is located in the south-western section of Osaka, at the mouth of the Shirinashi River which is capable of wharfing a ten-thousand ton steamer. Therefore, even the largest cable ship *Nanyo Maru* of the Department of Communications can be readily brought to its wharf. The site comprises 3,600 tsubo (about 3 acres) with 1,400 tsubo (about 1 acre) for the factory, office building and other auxiliary buildings.

Particular mention may be made of the improvement of the G.P. extruding machine. The old type of G.P. extruder can apply but one coating at a time. Therefore, it is necessary to cool the coating to acquire firmness and application of the chatterton compound is necessary for cementing layers before the second layer is extruded on. This process must be repeated for the third layer. The new machine installed eliminated this repetition of process and enables

(*Continued on page 479*)

Engineering in China*

Still Great Need for Foreign Help to Develop Industry

Engineering possibilities in China are usually discussed in the foreign press from the point of view of the foreign importer. It is true that there still remains, and will remain for many years to come, a wide market for imported plant and machinery of all descriptions. The tendency is, however, for such imports to consist more and more of heavy machinery, and goods produced in very large scale plants by highly technical processes, for in China, more especially of course in Shanghai, the growth of home manufacture has been very striking, though there are still many branches of production hardly represented at all.

The successive increases of the Customs Tariff are supposed to be mainly intended for the encouragement of home industries, and it is hardly surprising that China should have followed the example of all the leading nations in the world in the use of the tariff weapon for this purpose. There is, however, one very real danger to the best interests of the Chinese people in the present position under the tariff. There can be little doubt that, broadly speaking, the collection of duty is carried out efficiently and justly, without unfair discrimination, by the Customs officials. But it is currently believed, and apparently with justification, that purely Chinese firms are able to obtain, from the Government, rebates on import duty on their materials, and consequent reductions in operating costs, which are denied to foreign firms, manufacturing, also in China, similar products. This is perhaps only another symptom of the short-sighted nationalism which regards it as necessarily patriotic to make it as difficult as possible for foreigners to conduct business in China.

Well Trained Chinese

To any engineer, genuinely interested in the development of China for the Chinese, the future dangers of such a policy are very plain. There is not yet any considerable engineering tradition in this country. The foundation of the whole structure of industry other than agriculture and native hand trades, is being laid now, and upon the nature of the foundation will depend the stability of the whole edifice. Engineering of any kind, including almost all branches of modern manufacture, depends for its success on three principal factors. Adequate and properly controlled finance, expert technical direction and management, and the skill of the individual workman. Of the first of these nothing need be said here except that there is, and always will be, money forthcoming for sound enterprises in China, provided that the financial and technical control is in the hands of competent people of known honesty. As regards technical direction it is safe to say that for many years to come the *best* technical knowledge and experience will be found among foreign nationals, rather than from the Chinese themselves. Similarly it is true that the best practical engineers and workmen will be found abroad. If, therefore, China wishes to forge ahead as a industrial country she must be prepared to seek the quickest and best way of producing Chinese technicians, engineers and workmen equal in ability and experience to the best of other nations.

Nobody who has worked with well trained Chinese will refuse to admit that the best of them, who have gained their experience by working with expert foreigners, are very good indeed, and the amount of work they get through can be astonishing. But the habits of thoroughness and exactitude are readily lost unless there is some foreign control in the works or on the job. These habits are the real secret of success in all engineering or manufacturing work, and if it is desired to build up, from a race so essentially agricultural as the Chinese, a new generation of skilled engineers it will only be done by bringing as many of the workmen themselves as conditions permit into direct contact with foreigners and foreign methods.

A Supreme Folly

The exclusion of skilled foreigners willing to start works in the new country is the supreme folly in the case of a nation which wishes to develop such industries for itself. The benefits of the free admission of trained individuals from abroad has been proved again and again in the early stages of industrial development in other countries. There is every inducement for foreign firms to co-operate with Chinese in the development of works in this country, provided they can be sure of obtaining a fair deal. Discrimination against them is the chief deterrent to-day, for in spite of the many other factors which tend to discourage enterprise all over the world, there is a widespread belief among engineering firms of all nationalities that the possibilities in China in the near future are immense, even in face of such obstacles as the difficulty of enforcement of contracts and the unreliability of many dealers. If it could once be realized by the Chinese leaders that the quickest way to develop this great country for the Chinese themselves is by free and unrestricted acceptance of foreign experience and co-operation, the progress thereafter would astonish them and the world.

It is not intended to convey the impression that there are no reliable and skilled Chinese engineers. This is not the case. But there are far too few of them for the rapid development of the country, and in every instance they have learned their profession either abroad, or in Chinese institutions founded or staffed mainly by foreigners. Engineers in China and abroad, who have as a whole a real sympathy with and interest in this country, are willing to give of their best in its interests, provided only that the knowledge and experience they possess can be used freely, in full co-operation with the leaders of enterprise, without fear of favor.

Chinese Quick Learners

The manufacturer or engineer starting a new undertaking in China knows that he will have to spend considerable time and effort in training his personnel, but Chinese are quick learners, and what they learn thoroughly they retain, and it is often better to take an entirely untrained man and teach him, rather than to employ one who has learned a little and thinks he knows a lot. For this reason it is the more important that during the coming years the receptive minds of the younger generation should be brought more and more closely into contact with trained and practical teachers.

The number of foreign trained Chinese engineers returning from abroad is increasing steadily. Education, *per se*, in engineering is worth very little. It is not enough that foreign professors should give lectures which the average Chinese student can repeat word for word months afterwards. He must be taught to apply his knowledge to the practical problem in front of him. Not only so but he must realize fully that skimping does not pay and that it is false economy to use materials that are " good enough " and which let him down in the long run. It is this kind of knowledge which alone can be gained by practical experience of the best methods, and constant supervision to see that he carries them out to the last detail. Actual experience in China, side by side with foreign engineers, would enable these returned students to derive the full benefits from their expensive training abroad, which is now in so many cases entirely thrown away for lack of such partnership. They need to realize that any engineer continues to learn as long as he lives, and that the best opportunities for education are usually to be found after, rather than before diplomas and degrees have been obtained.

It is perhaps a lot to expect that any great change in the general attitude of mind to these problems can come about quickly. At the same time if a few of the more enlightened leaders of Chinese commerce and engineering, who are beginning to appreciate realities, would have the courage to look further ahead, and to proclaim their willingness to welcome fully and genuinely the co-operation of the foreign engineer, they would be doing a great service to their country.

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* From the *North-China Herald*.

Economics and Practice of Rural Automatic and Semi-Automatic Telephony in Malaya*

By R. E. ROBERTS

As the following paper is intended to show how far a Rural Automatic Telephone System can help to solve the problem of providing cheaper telephone services, it is advisable in the first instance to review the problem in a general way and to see what has been, or is being, done to provide a solution.

For the purpose of this review subscriber's lines fall into two main classes :—

(*a*) those within the two miles radial distance of an exchange where the annual line costs are relatively low in comparison with the operating costs.

(*b*) those beyond this limit where the annual line costs are high in comparison with the operating costs.

This classification gives two main axioms to work upon. These are :—

(*a*) for short distance subscribers, reduce the operating costs.

(*b*) for long distance subscribers, reduce the line costs.

For the (*a*) class, the obvious solution is to charge a relatively small line rental and a small fee for each call. This system is known as *Message Rate* and is acknowledged to be the most equitable arrangement possible. Unfortunately, however, subscribers in this country have been accustomed in the past to the *Flat Rate System*, that is to say, an "all-in" rental, inclusive of line and operating charges, and which is applicable irrespective of the number of calls made. To change over to *Message Rate* would mean that the majority of subscribers would benefit, but the large users would find their annual costs very much higher. At the present time this would mean considerable hardship. How far it would be possible to reconcile the two systems, by giving suscribers the option of *Message Rate*, or a slightly higher *Flat Rate* than that at present existing, is under investigation, and it may eventually be found possible to adopt some system which will afford relief to small users without unduly penalizing large users. In the meantime, the concessions of three-monthly agreements and payment of subscription in quarterly instalments have helped the small user to some extent.

For the (*b*) class (the long distance subscriber), the total annual rental, which is mainly made up of line charges, would not be materially affected by any change in the method of charging for operating. Furthermore it is impossible to reduce the annual charge per mile of wire (as it is already lower than the all-in annual cost of up-keep. The only method of affording relief to this class, therefore, is to make one line suffice for more than one subscriber, and there are three workable methods of doing this.

(i) By allowing the subscribers to share a single exchange line, thereby constituting a simple "party line," without secrecy.

(ii) By using automatic apparatus to provide secret "party line" working for any number of subscribers up to ten.

(iii) By establishing small fully automatic or semi-automatic exchanges near to groups of subscribers who would otherwise have to rent individual lines to a distant exchange.

Arrangements have been made for any of these three arrangements to be adopted in suitable circumstances, and the following is a more detailed consideration of the application of the two latter methods.

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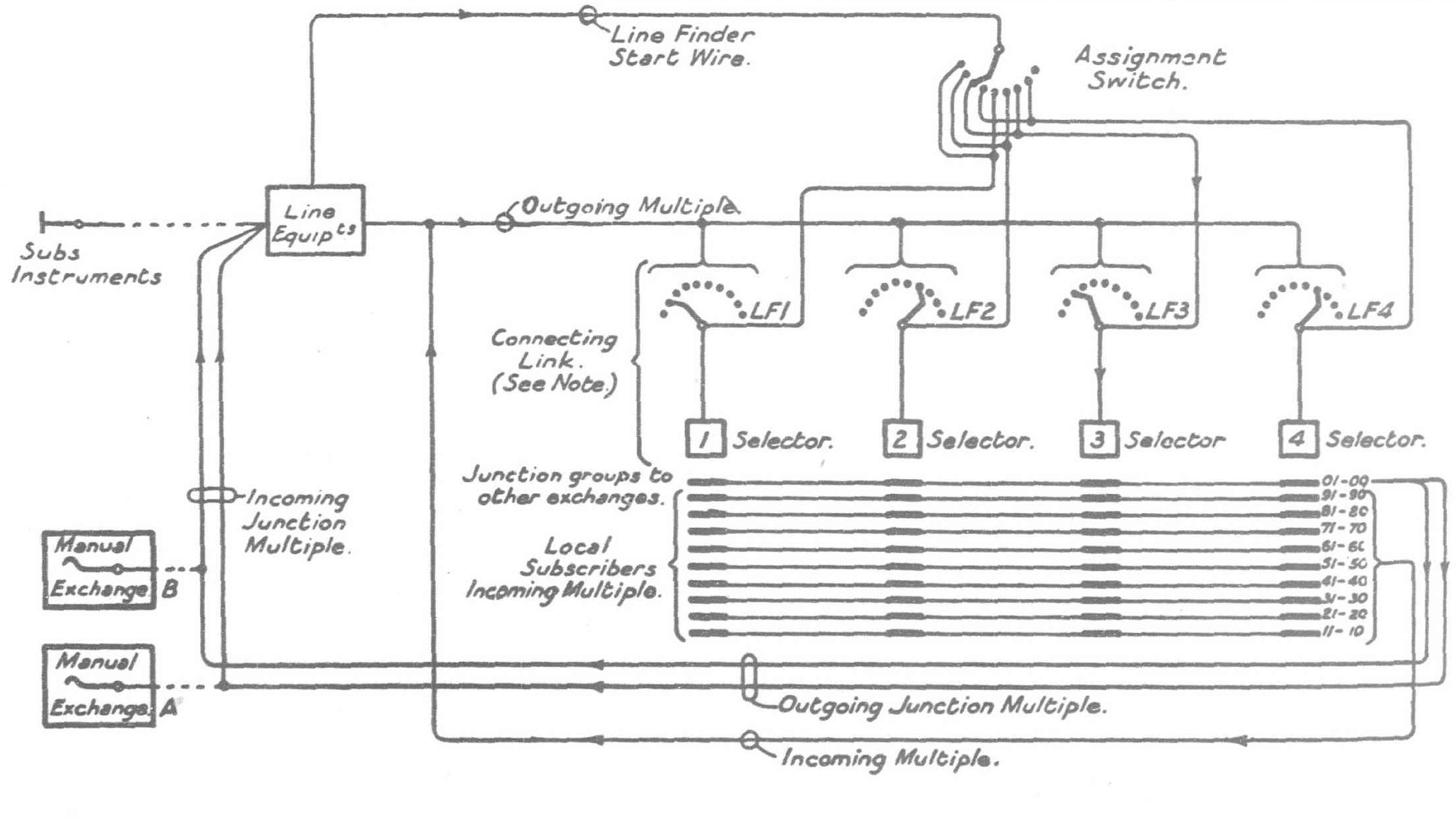
* *Quarterly Journal of the Engineering Association of Malaya*



Note :- A connecting link consists of a line finder and its associated selector.

UNIT AUTO. Nº 5.

RURAL AUTOMATIC EXCHANGE.

ELEMENTARY CONNECTIONS OF A 25 LINE UNIT.

Fig 1.

Small Fully Automatic Units

Small groups up to a maximum of 100 lines, at present worked manually, can be catered for by Automatic Units of various types which will be described later.

In considering the conversion of such a Manual Exchange to a Rural Automatic Exchange of a similar size, the following requirements are necessitated :—

(1) The numbering scheme, being a two digit one, requires that certain subscribers with a single digit number must have their numbers changed.

(2) Subscribers must be able to call any other line connected to the same Exchange automatically, by dialling.

(3) That in the absence of an operator, calls to the adjacent Manual Exchange must be catered for, and discrimination given, assuming that the Automatic Unit is situated in such a locality that it is central to other Manual Boards.

(4) The subscribers' instruments must be changed, except where Central Battery speaking telephone circuits are existing, and dials have to be provided.

Semi-Automatic Units

The case for (*c*) represented by subscribers on Estates or Mines is different, and more generally speaking it is found that these lines are strung out along roads rather than grouped in close formation. The agreement basis and rental charges are here again based upon the length of line outside the two miles radius from the Exchange to which they are connected, and the only way to effect relief, is to "take the Exchange to the subscriber," and so reduce the length of line.

The Semi-Automatic Unit has therefore been introduced, and is a small equipment which selects automatically a connection to the Exchange to which the subscriber was previously connected. It is placed in the most conveniently central position for the subscribers to be fed, and is built to accommodate ten subscribers' lines, with either one or two Junctions to the Parent Exchange.

By *Semi-Automatic* it is meant that the subscribers use the generators of the existing telephones to effect calls to the Manual Exchange, whilst, by dialling over the Junction, the operator automatically selects one of the ten subscribers required. The following requirements are necessary for the transfer of subscribers from a Manual Exchange to a Semi-Automatic Unit.

(1) The numbering scheme is a single digit one, the subscribers being selected over a junction by the dialling of numbers "1" to "0," "0" being the equivalent of "10." Two digit numbers must therefore be changed.

(2) Calls from unit subscribers must be extended to the Junction or, in the case of a two junction unit, to the first available Junction so as to call the operator at the Manual Exchange.

(3) If the "Connecting Links" or Junctions are engaged the other subscribers calling must receive an "Engaged Tone."

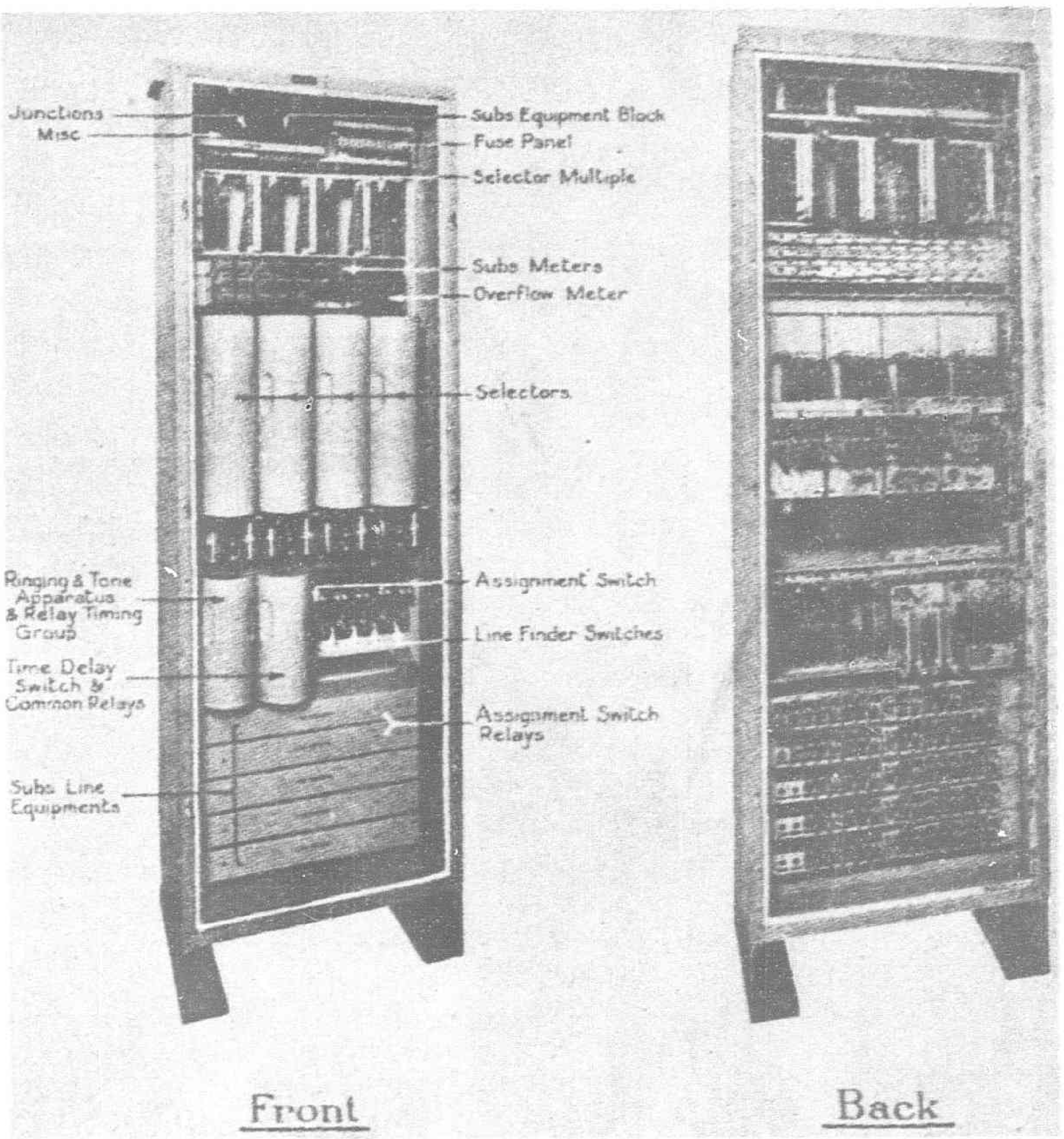


Fig. 2.—25-Line Rural Automatic Exchange Unit (Unit Auto No. 5)

(4) The subscribers' instruments remain unchanged except in certain cases where the generator handles require to be re-connected, that is, where subscribers have previously called by merely removing their receivers.

It will thus be seen that a Semi-Automatic Unit is, in effect, a "Restricted Service Selective Secret Party Line," accommodating up to ten subscribers with the use of either one or two channels for connecting purposes.

General Policy

There are many factors which have to be considered from the point of view of General Policy before such steps or re-arrangements are undertaken, and of these the following may be cited :—

Service to Public

The service offered to the Public is of prime importance, and the equipments to be installed must provide the equivalent facilities of the existing Manual Boards, except in the case of Semi-Automatic Units which are representative of Party Line working, and do not offer the same service as direct Exchange lines.

In the case of Fully Automatic Units the number of connecting links, or the number of equipments to provide the maximum number of connections at any one time, must be adequate.

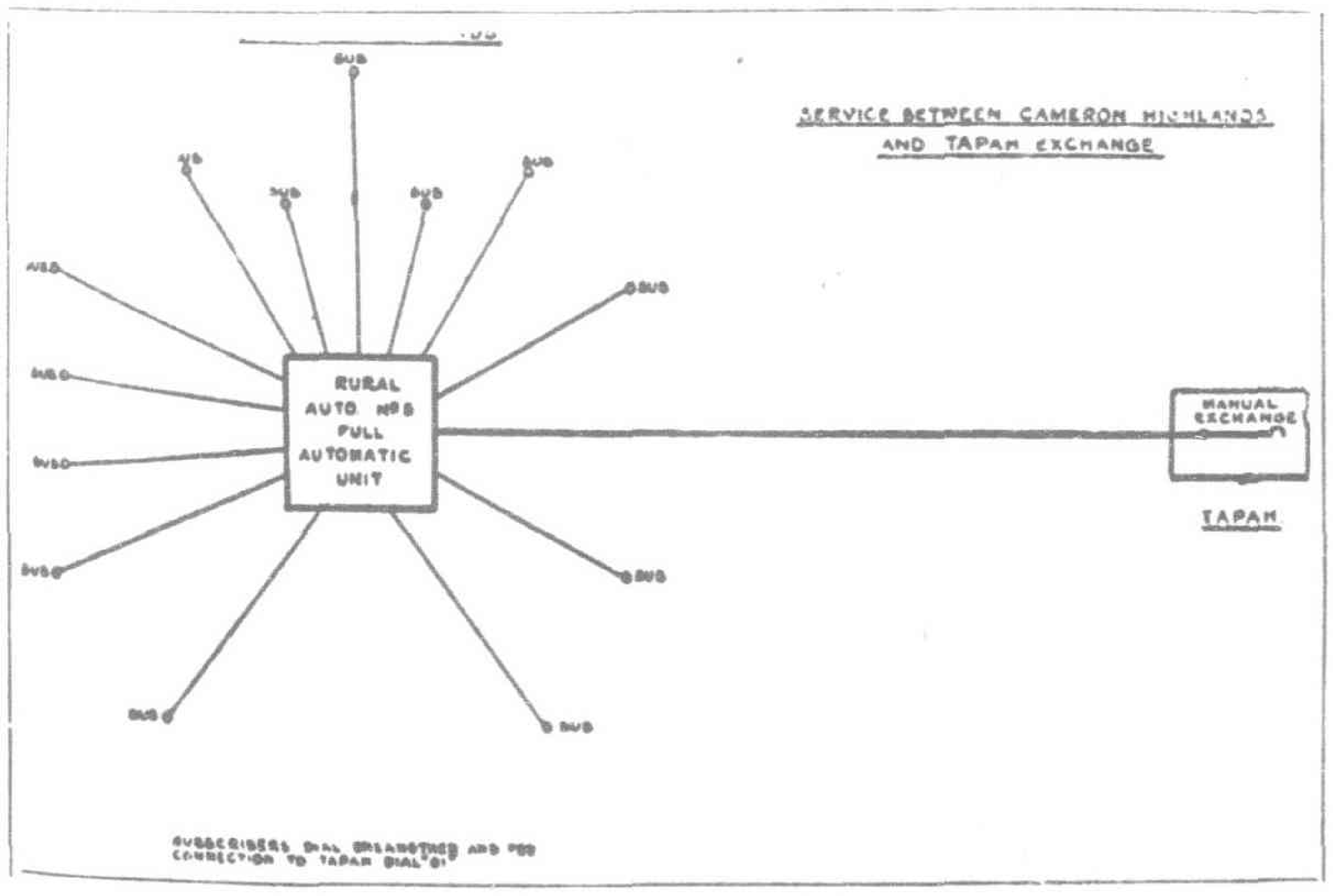

SERVICE BETWEEN CAMERON HIGHLANDS AND TAPAH EXCHANGE
SUB
RURAL AUTO No 5 FULL AUTOMATIC UNIT
MANUAL EXCHANGE
TAPAH
SUBSCRIBERS DIAL ... AND FOR CONNECTION TO TAPAH DIAL "0"

Fig.—3

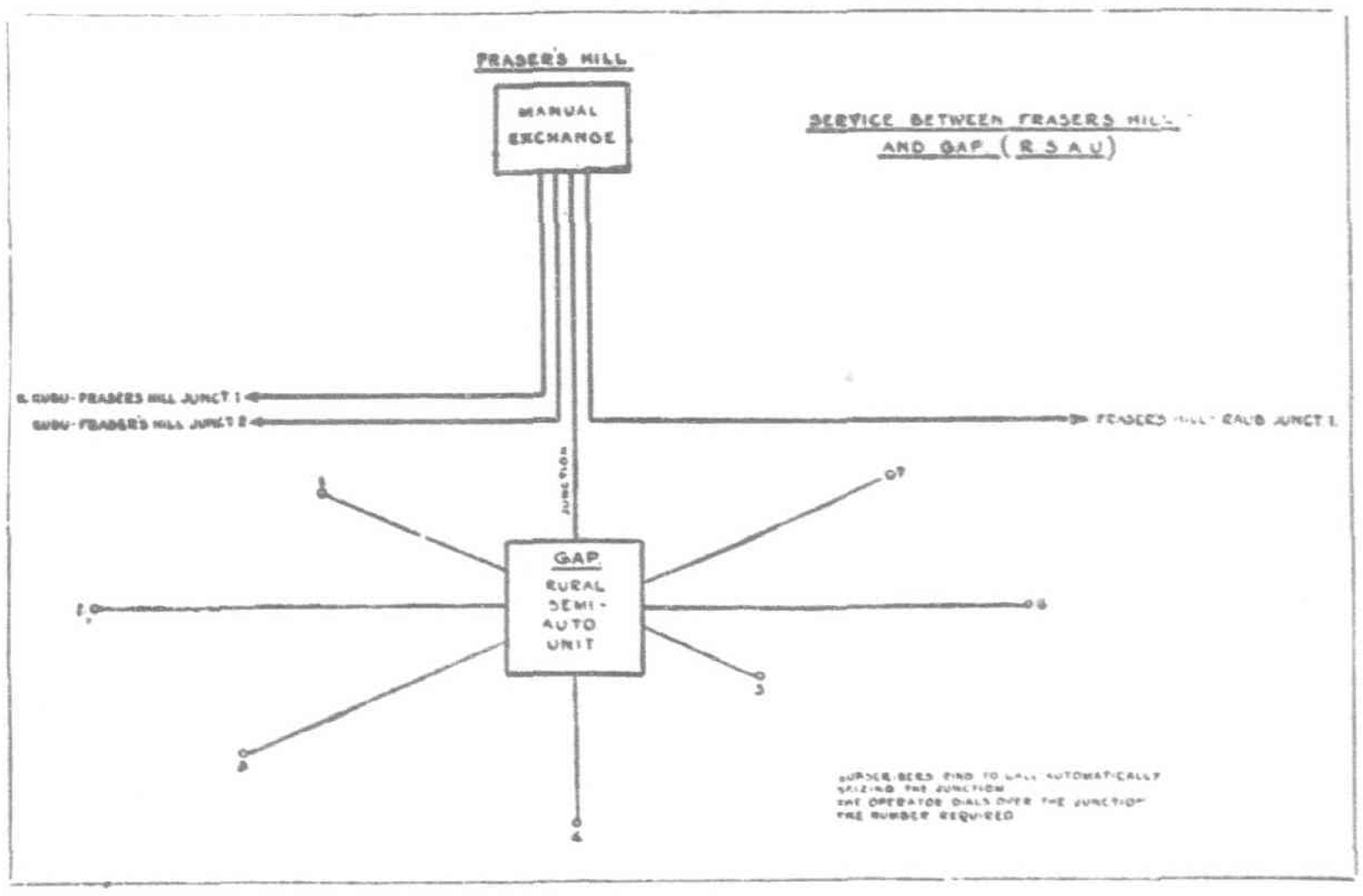

FRASER'S HILL
MANUAL EXCHANGE
SERVICE BETWEEN FRASERS HILL AND GAP (R S A U)
KUBU - FRASERS HILL JUNCT 1
KUBU - FRASER'S HILL JUNCT 2
FRASERS HILL - RAUB JUNCT 1
JUNCTION
GAP
RURAL SEMI-AUTO UNIT
1
2
3
6
SUBSCRIBERS RING TO CALL AUTOMATICALLY SEIZING THE JUNCTION THE OPERATOR DIALS OVER THE JUNCTION THE NUMBER REQUIRED

Fig.—5

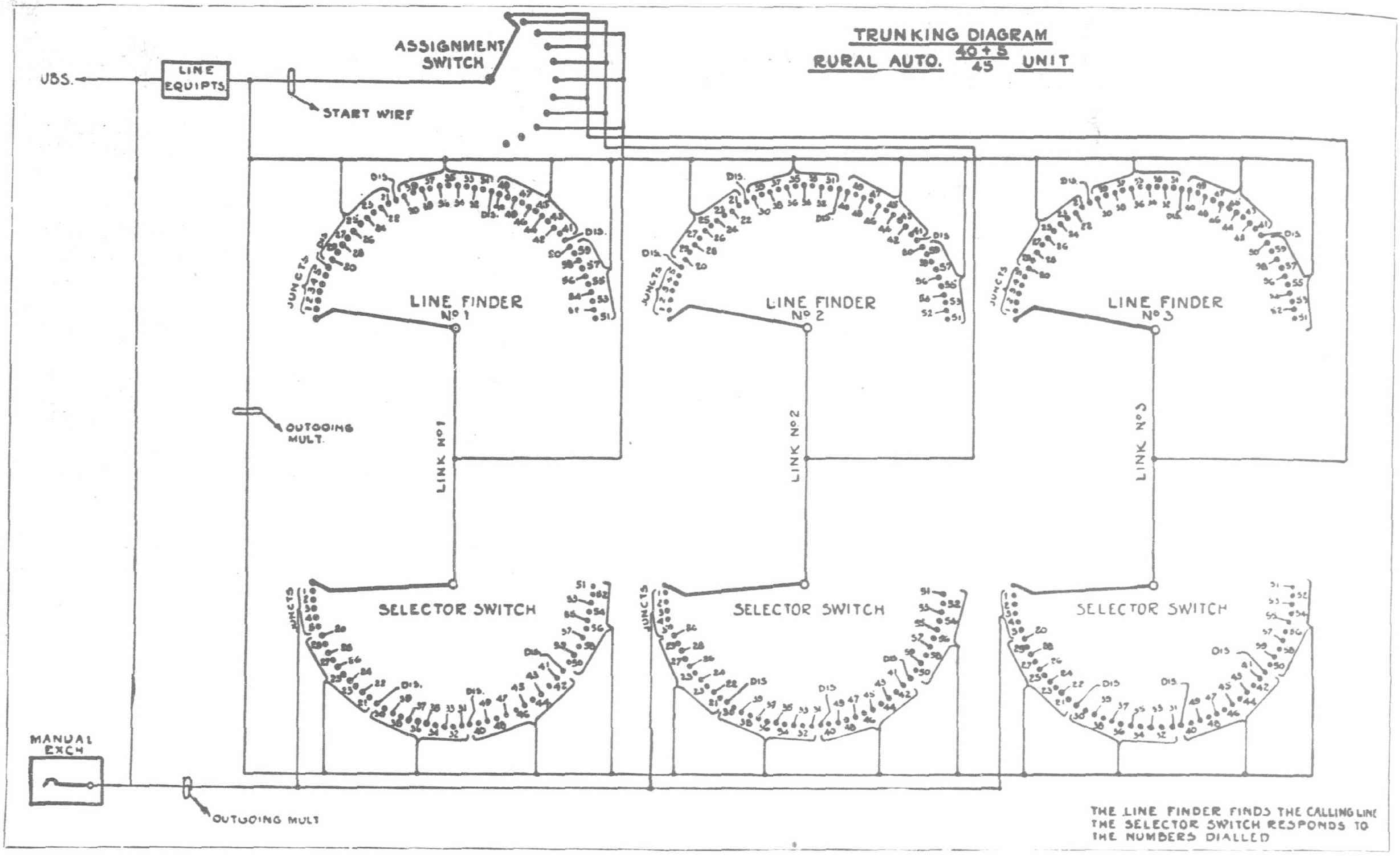


Fig.—4

General Trading Conditions

(1) In prosperous times will the same Policy be applicable ?

(2) The effect of retaining lines at reduced rental as opposed to their total loss.

(3) Subscriber's option to have Semi-Automatic Unit facilities at reduced rates, or Direct Exchange Lines at full rental rates.

(4) Reduced rates may tempt subscribers, who have foregone their telephone installation, to have it reinstalled, so that new lines are not improbable.

(5) In cases where one unit is more than seven miles by route from another Exchange, a Junction charge is made ; thus the revenue from Junction circuits increases.

What will be the eventual outcome from a financial standpoint and is it economically sound to withstand a temporary loss with a view to ultimate gain ?

Apparatus and Installation Costs

The initial cost of the apparatus to be installed has to be carefully considered. The utilization of apparatus on hand, incorporated into the different types of Units by the Department's own Workshops, considerably reduces initial expenditure from what it would be if such units were purchased in the open market, whilst at the same time the work benefits the Department financially and otherwise.

The initial consideration is of prime importance as route construction must be greatly effected by the Policy adopted.

Operating costs are considerably reduced, since Fully Automatic and Semi-Automatic Units, which replace Manual Switch-boards, will work without attention, operators being required only at the Manual Exchange termination points.

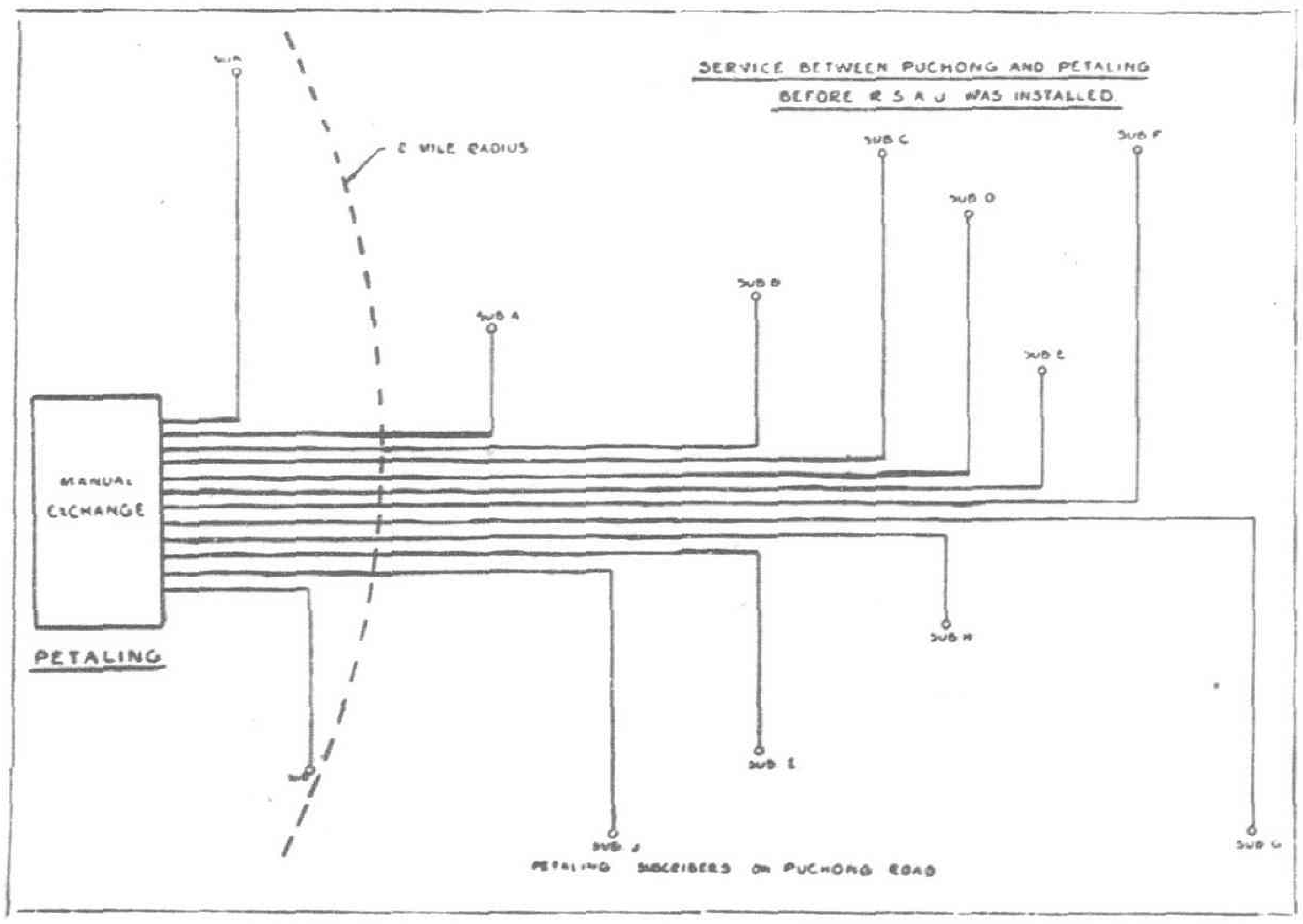

SERVICE BETWEEN PUCHONG AND PETALING
BEFORE R S A U WAS INSTALLED.
E MILE RADIUS
MANUAL EXCHANGE
PETALING
SUB A
SUB B
SUB C
SUB D
SUB E
SUB F
SUB G
SUB H
SUB I
SUB J
PETALING SUBSCRIBERS ON PUCHONG ROAD

Fig.—6

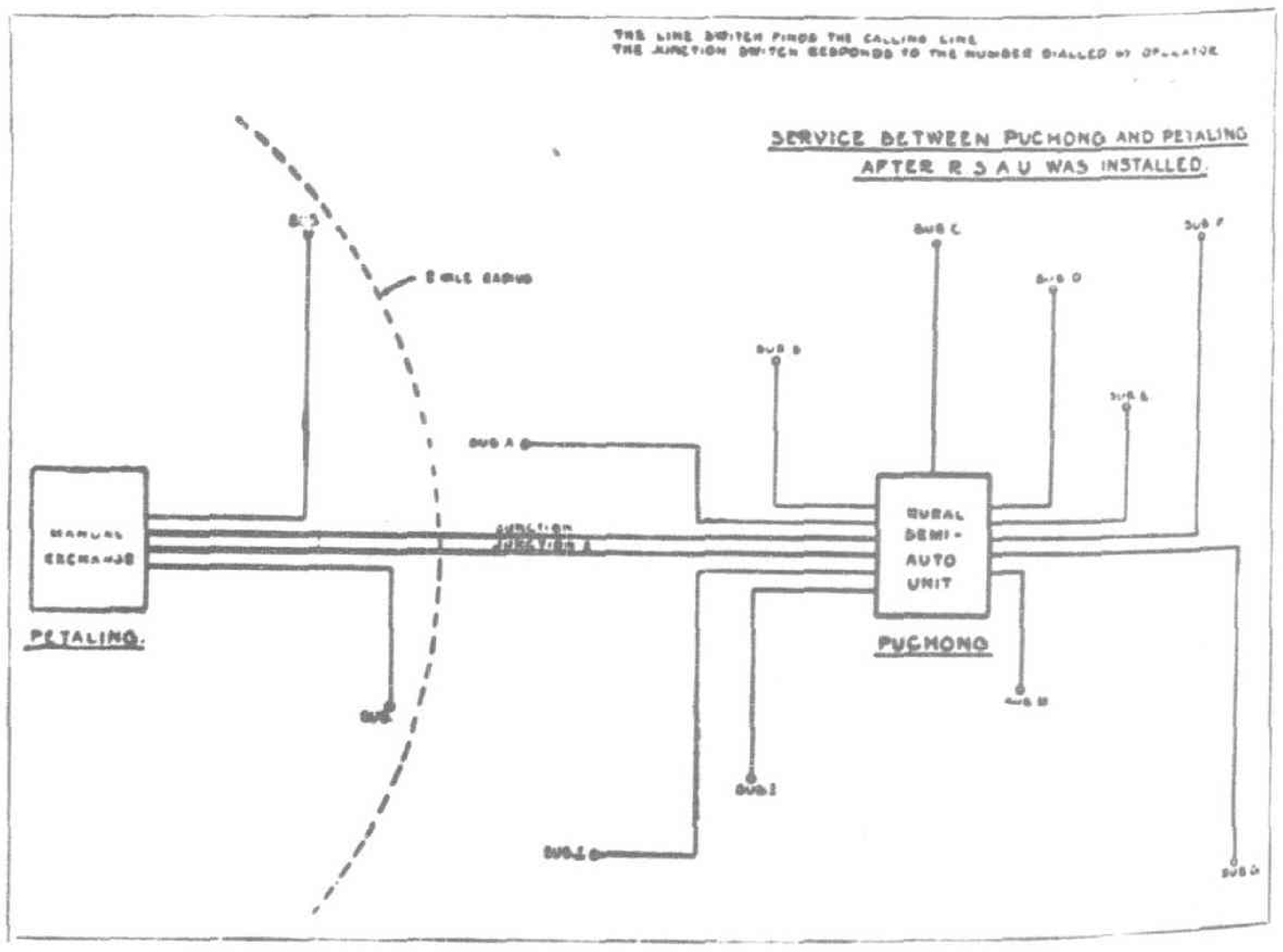

THE LINE SWITCH FINDS THE CALLING LINE
THE JUNCTION SWITCH RESPONDS TO THE NUMBER DIALLED BY OPERATOR
SERVICE BETWEEN PUCHONG AND PETALING
AFTER R S A U WAS INSTALLED.
8 MILE RADIUS
MANUAL EXCHANGE
PETALING.
JUNCTION
JUNCTION 2
RURAL SEMI-AUTO UNIT
PUCHONG
SUB A
SUB B
SUB C
SUB D
SUB E
SUB F
SUB G
SUB H
SUB I
SUB J

Fig.—7

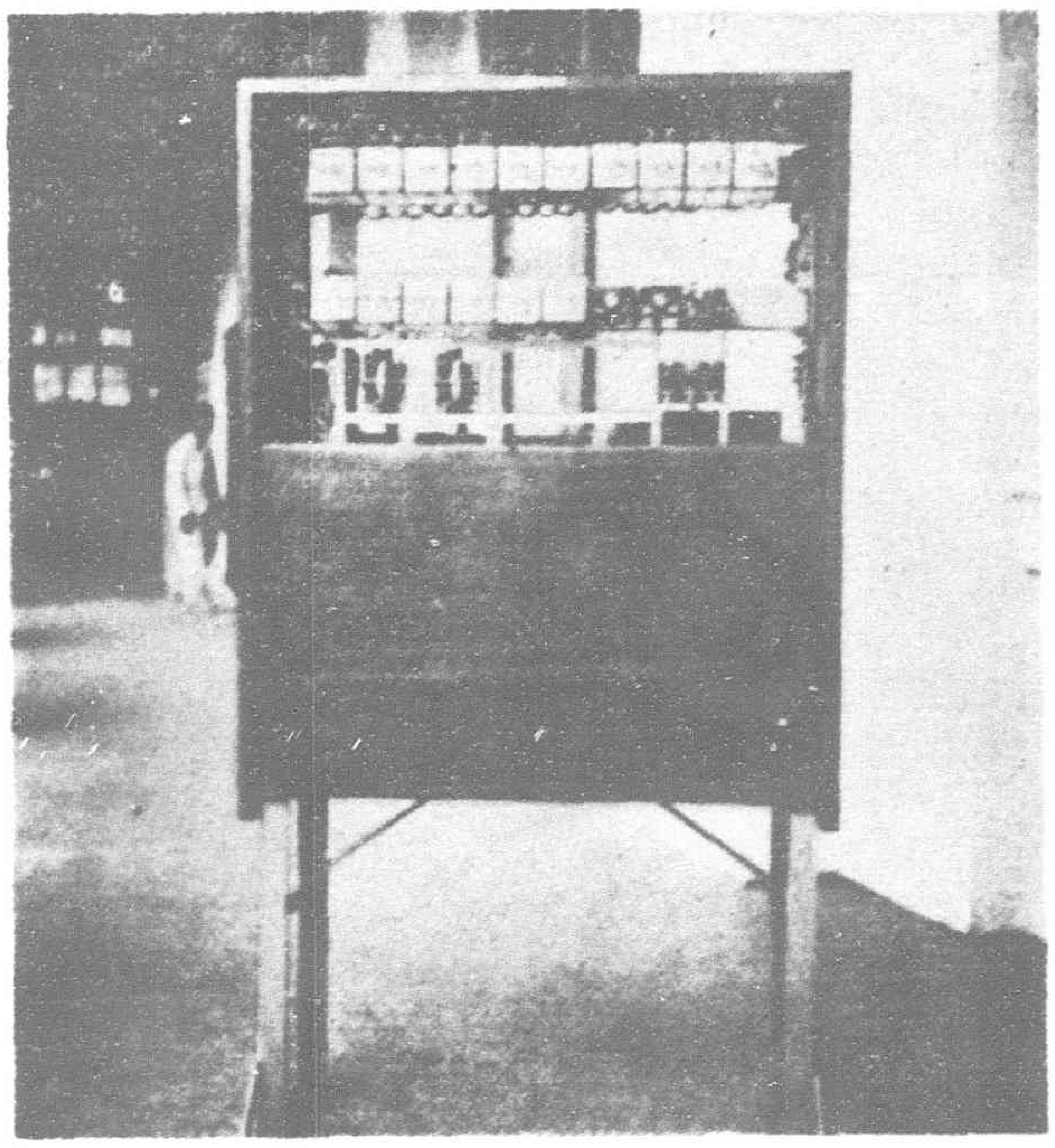


Fig.—8

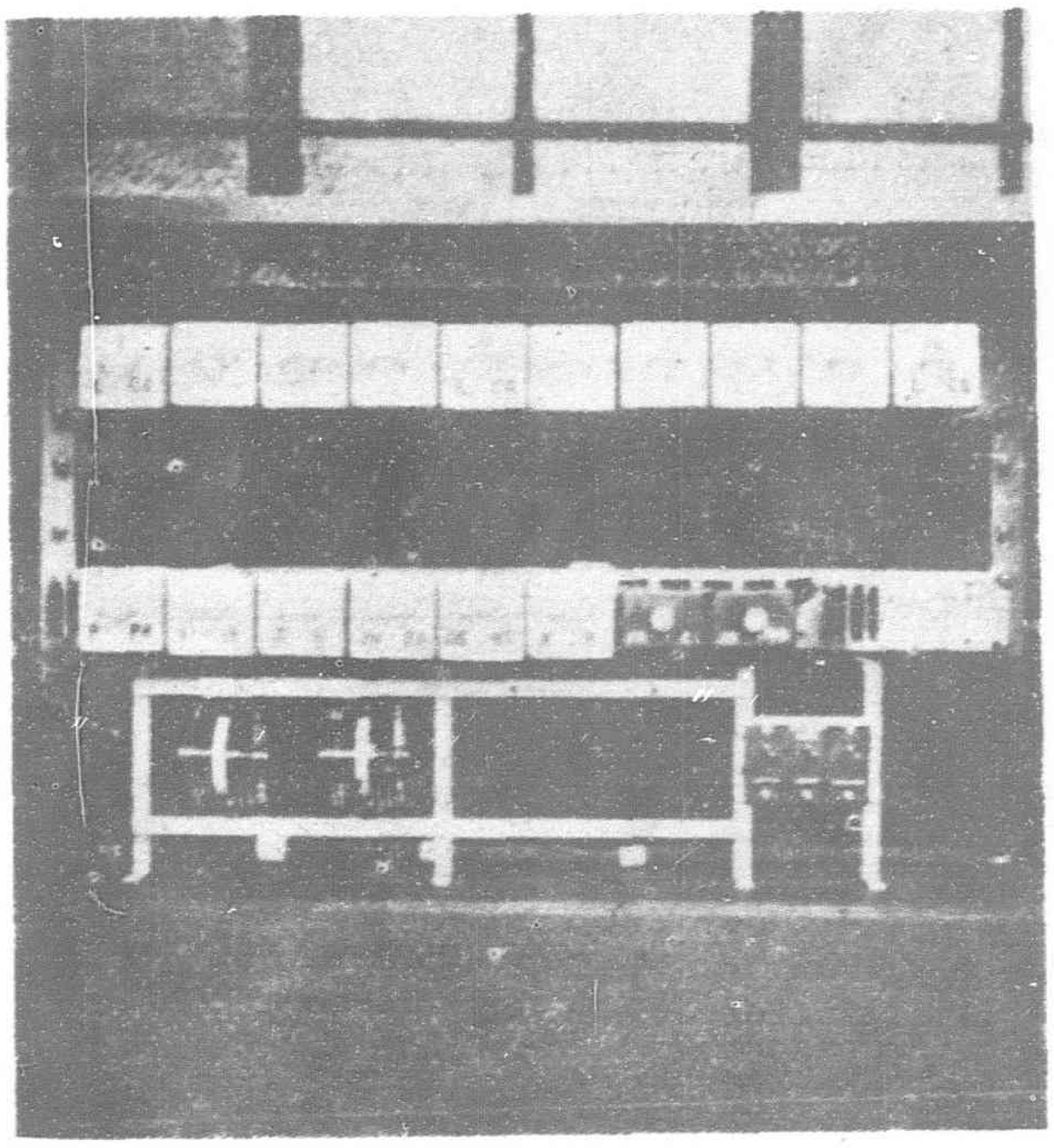


Fig.—9

Maintenance Costs

Apparatus. — Maintenance costs must increase, as Secondary Cell batteries and charging equipment are required for the Fully Automatic Units as well as large primary battery sets for the Semi-Automatic Units.

Line.—Long lines are maintained at a loss, so that where the Exchanges have been "taken to the Subscriber," the line losses are thereby reduced. On the other hand the Junction route maintenance charges are affected by the fact that, on a "per line" basis, single lines are more costly to maintain than multi line routes.

Staff. — The introduction of more complicated apparatus necessitates greater attention by the higher grades of Technical Subordinates, and, moreover, the serious training of Asiatic workers has to be undertaken if the staff is to become *automatically minded*.

General Electric Co's Unit Auto No. 5

The automatic apparatus is assembled in units, each having a capacity of 25 lines. Four selectors of the Strowger type, each associated with a line finder, are accommodated in very unit, and provide the means of connection between subscribers and junction circuits. One selector and its associated line finder form a connecting circuit, termed a "Connecting Link."

Each of the 25 lines in one circuit is multipled over the banks of the four line finders. When more than one unit is installed, all the banks of the selectors in all the units are multipled together so that any selector has access to any line on the exchange. The trunking diagram illustrated in Fig. 1, shows the connections of a Rural Automatic Unit No. 5. Fig. 2 depicts a 25 line unit.

When a calling subscriber removes the receiver, the apparatus associated with the line causes a signal to be transmitted over the "start wire," via the assignment switch and bank contact, to one of the four line finders in the unit containing the calling line. The line finder hunts for the line and, when it has been found, the calling subscriber is extended to the selector. The assignment switch wipers are then stepped round to the bank contacts of the next free connecting link. The subscriber now dials the two digits required.

The first train of impulses, the tens digit, causes the selector wipers to be raised vertically to the level of the number dialled. The second train, the units digit, rotates the wipers to the bank contacts of the required subscriber's line number on that level. When the second digit is dialled, certain relays in the common apparatus are operated and ringing current is generated. Interrupted ringing current is automatically applied to the called subscriber's line, and "Ringing Tone" is transmitted to the calling subscriber. When the called subscriber removes the receiver, the ringing current is cut off during the "silent period," and the speaking circuit is established. When the calling subscriber replaces the receiver, the selector is released, but the wipers of the line finder remain on the bank contacts of the calling line until another calling subscriber seizes the connecting link.

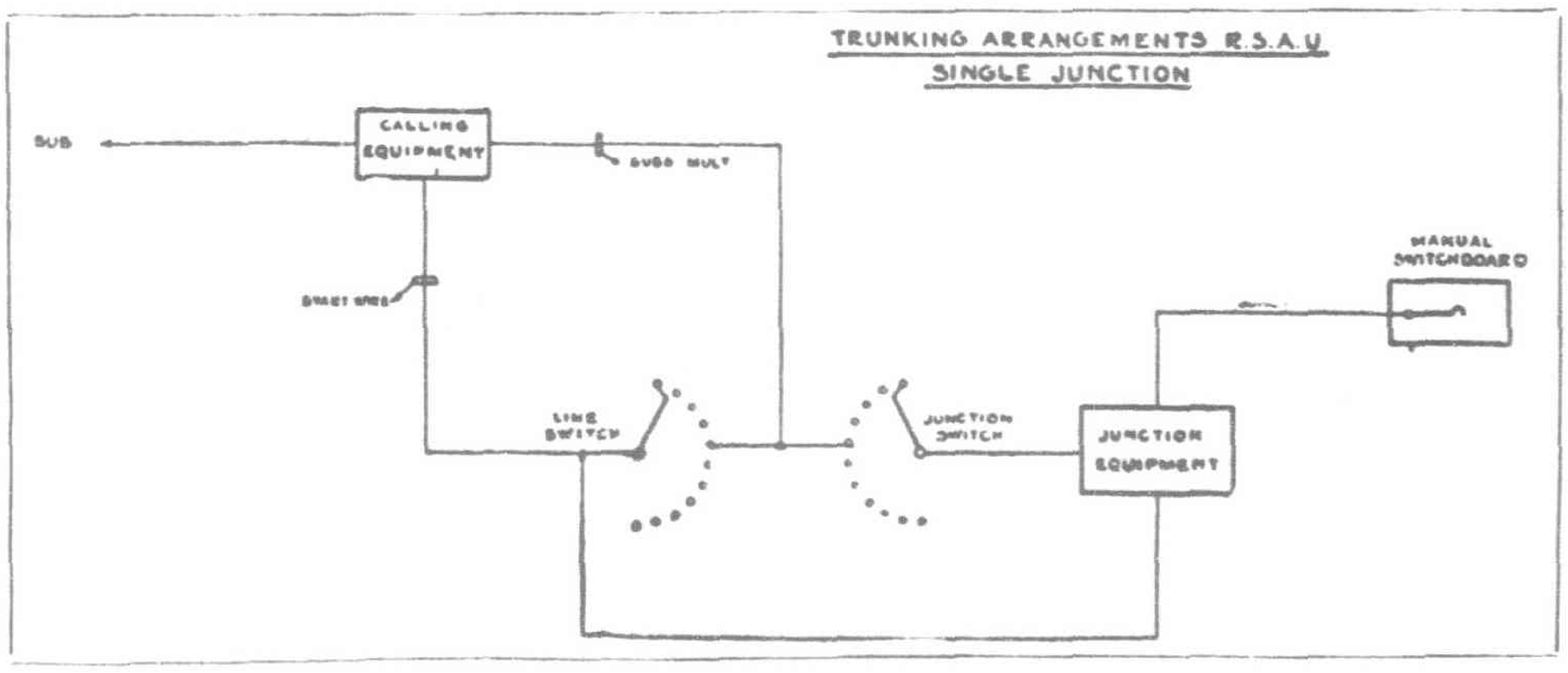


Fig.—10.

Level "0" of the selector is reserved for junctions to other exchanges, the lines to each exchange terminating in groups of consecutive bank contacts. A calling subscriber requiring connection to an exchange dials "0" and one other digit which is dependent upon the exchange required. The second digit rotates the wipers to the bank contacts of the first junction line to the required exchange. If that line is engaged, an automatic rotary hunting circuit is brought into use, and the wipers rotate until a free line to the exchange is found. The wipers remain on the free line, ringing current is transmitted to the line and causes a calling signal associated with the junction to be operated in the distant Manual Exchange, whilst "Ringing Tone" is returned to the calling subscriber. In the event of the lines to the required exchange being engaged, the selector wipers are rotated to the bank contacts of the last line in the group, and "Busy Tone" is returned to the calling subscriber.

When the junctions are worked on a bothway basis, they terminate in the rural exchange on line equipment and on the line finder bank multiple as ordinary subscribers' lines. Hence an incoming junction call is similar to that of an ordinary subscriber.

Should a subscriber dial a number which is engaged, "Busy Tone" is returned. When a spare number is dialled, "Number Unobtainable Tone" is transmitted to the calling subscriber.

In practice, these units have proved themselves to be very satisfactory and many hundreds are now installed throughout the British Isles. They are worked from 50-volt secondary cells, and suitable charging plant is necessary. Such a unit has been installed at Cameron Highlands and is shown in Fig. 3.

The junctions from these units always terminate on Manual Boards. They can be divided into different groups, so that a subscriber can call different exchanges which are connected to the unit, and as these exchanges are Manual, the operator completes the call.

The facility of "Through Dialling," or one subscriber dialling another on a different unit, is not normally catered for, but it must be appreciated that one type of unit cannot be made suitable for all requirements.

Fully Automatic Unit $\frac{40+5}{45}$

To cater for local conditions, where the Manual Exchange circuits in use are not identical to those in England, and to provide inter-unit traffic in cases where exchanges are in " String " formation, the use of the $\frac{40+5}{45}$ Fully Automatic Unit is now being considered for this country.

It is a unit accommodating up to 40 subscribers with a maximum of five Junctions. When a subscriber removes his receiver he is connected through the medium of an " Assignment Switch " to a " Connecting Link." This consists of a single motion rotary switch, the " Line Finder " and a second switch of a similar type to which the numbers are subsequently dialled.

The " Connecting Links " are picked up in turn to ensure even wear on all parts of the apparatus. Should a call become ineffective due to a faulty " Link," the subscriber by replacing his receiver and redialling is automatically connected to another " Link."

The main difference between this and other units is that the " Two Motion Selector," which normally rises and rotates to dial impulse trains, has been replaced by a " Single Motion Switch," or one which rotates only. This reduces initial cost and provides one standard piece of apparatus for all purposes. From a maintenance point of view, with Asiatic staff, this facilitates the training of men who are to maintain the units. Standard facilities, Ringing, and the usual " Tones " are provided.

Trunking Arrangements

Fig. 4 shows the general principle of the Trunking Arrangements. When a subscriber dials another on the same exchange the first train of impulses causes the 50 point Rotary Line Switch to rotate its wipers to the particular tens group which has been dialled, whilst the second train finds the particular one required in that ten, so that two digit dialling is accomplished on a single motion switch.

A separate group of relays and another Rotary Line Switch provide for the Ringing, " Dial Tone," " Busy Tone " and " Number Unobtainable Tone."

The circuit caters for :—

(*a*) A subscriber dialling another subscriber or calling the Manual Operator by Ringing.

(*b*) A subscriber to " Through Dial " to another subscriber on an adjacent Automatic Unit.

(*c*) The Manual Termination equipment provides for the use of any switch-board circuit already existing.

(*d*) The operating procedure is the same as for the present and known method of working, so that standard operation applies to all.

The Semi-Automatic Unit or the 10 Party Secret Selective Party Line

Before explaining the working of one of these equipments two examples of how they are useful will be given.

Example 1.

The subscribers at The Gap (seven in number), (shown diagrammatically in Fig. 5), were formerly connected to a small Manual Switch-board where the calls were extended to Fraser's Hill and thence to other groups—Kuala Kubu on the one side and Raub on the other.

It was formerly necessary to employ operators to cover a 24 hours service. A unit has been installed at The Gap which provides for any of the seven subscribers to call Fraser's Hill automatically, and if the call is to another subscriber at The Gap then the operator at Fraser's Hill dials back over the junction, automatically selecting the number required and to which the operator then sends the ringing current. It will be seen that the services of The Gap operators were thereby dispensed with.

Example 2. (Shown diagrammatically in Figs. 6 and 7).

Petaling, an exchange some 5½ miles from Kuala Lumpur on the Klang road, feeds subscribers over a wide area, including all those to the end of the Puchong road. The last subscriber on the route is 16 miles from Petaling.

A unit has been installed at the Puchong Post Office, seven miles from Petaling, into which nine subscribers' lines, which were previously connected to Petaling Exchange, are now diverted. Two Junction circuits are provided between Puchong and Petaling. In effect the exchange has been " taken to the subscriber," thus saving those subscribers a considerable quarterly rental.

In this case, if a new Puchong subscriber wishes to call another Puchong subscriber, he turns his generator handle which automatically seizes one of the disengaged junctions and the call is extended to Petaling. The operator then dials back over the same junction and rings the wanted party, and the call being a local one no charge is made. If the subscriber desires a call to Kuala Lumpur, the Petaling operator extends the call and the appropriate junction fee is charged to the calling party.

Fig. 6 illustrates the case where, under the former arrangements, the subscribers were fed from a Manual Exchange over lengthy lines, whilst Fig. 7 shows how the same subscribers are fed to a centrally located Semi-Automatic Unit fitted with two junctions.

Operation of the Semi-Automatic Unit

Figs. 8 and 9 show the complete unit, and Fig. 10 indicates the connecting arrangements. The units have been designed to work from primary batteries of the A.D. type, thereby dispensing with a power supply and with secondary batteries.

When a subscriber rings, the Line Finder in the Unit is caused to rotate by conditions set up over the " start wire," and finds the line that is calling, automatically extending the calling party to the Junction. A call is received at the Manual End through the medium of the Junction equipment. If the call is for another subscriber on the same Unit, the operator withdraws the " answering plug " and inserts a " calling plug " to which the dial is connected.

The set up connection is retained by the calling party with his receiver removed. The operator dials back over this same junction the number required, thereby stepping the Junction Switch to the wanted subscriber's line, and then rings in the usual manner. The calling party is disconnected from the Junction during this period, but is immediately reconnected when the ringing ceases. The two subscribers then converse together with the operator in " Tee " for supervisory purposes. When the receivers are replaced the clearing lamp lights and by withdrawal of the plug the unit resets itself.

In the case of the Two Junction unit, if one Junction is in use and another call is made, connection is effected to the second Junction. The call is dealt with as before except that the operator, after dialling, listens for a " Busy Tone " which, if received, indicates that the wanted subscriber is engaged.

A subscriber calling during any period that the Junction or Junctions are engaged receives a continuous buzzer tone indicating that connection is not possible at the moment.

China's First Combed Wool Filature in Shansi

A contract has been signed by Marshal Yen Hsi-shan, the Governor of Shansi, with the French Firm Le Materiel Technique, 6A Kiukiang Road in Shanghai, for the delivery of the material necessary for the complete equipment of a filature for combed wool to be established at Taiyuanfu.

The machinery of this new plant will be supplied from France by the Societe Alsacienne de Constructions Mecaniques, of Mulhouse. The cost is estimated approximately at 2,000,000 francs. A specialist from France will attend for the installation of the machinery required by a modern filature for combed wool.

The new filature will be the first of its kind to be operated in China, as only a few filatures for carded wool now exist in this country. It is of interest to state also that the above mentioned French firm of Mulhouse was the one that has, in a way, introduced the combed wool industry in Japan, having supplied the equipment of the largest filatures existing in that country.

Le Materiel Technique, the local representatives for the Societe Alsacienne de Constructions Mecaniques, have in their records a number of other important contracts, like one signed in 1931 with the Nanking City Government for the delivery of a huge quantity of canalization cast iron pipes, supplied by the Societe Francaise de Pont-A-Mousson, another world-known French foundry. In the beginning of this year a contract was signed with the Ministry of Railways for the supply of railway material (rails, locomotives, etc.) for a total running to 50 million francs, the first shipment being due to arrive shortly in Shanghai.

Protective Rubber Covering for Propeller Shafts

By *Y. TAJI, M.Eng., M.I.N.A., M.I.Mar.E.*

For protection against the corrosion and erosion of propeller shafts exposed to sea water, various processes have hitherto been introduced, including brass sleeves, oil immersion stern tubing, cloth or rope winding and protective painting. In special cases, the fescolising process, electrolysis eliminators and vulcanized rubber covering have been recently adopted.

In accordance with the Japanese Government Regulations for Ship Inspection, the propeller shaft protected by brass sleeves and oil immersion stern tubing must be inspected every third year, whilst that with cloth or rope winding and protective painting should be examined every second year. This obviously shows the official recognition of the superiority of the first two methods, but from economic viewpoints, these have been used only in superior classes of vessels.

Brass sleeves are very expensive and the work is very difficult for a large diameter of shafting, whilst the original tightness even under very perfect work has often been loosened after the lapse of time. Particularly, when a number of sleeves are joined together in order to attain a required length, it has frequently opened up at the joined parts, and further in view of the weight and the galvanic action with hull, this process cannot be considered ideal for the purpose.

The oil immersion process was developed some twenty years ago, but it has not been very popularly adopted, probably due to the running expense in addition to a comparatively high initial cost and also the liability to the leakage of oil.

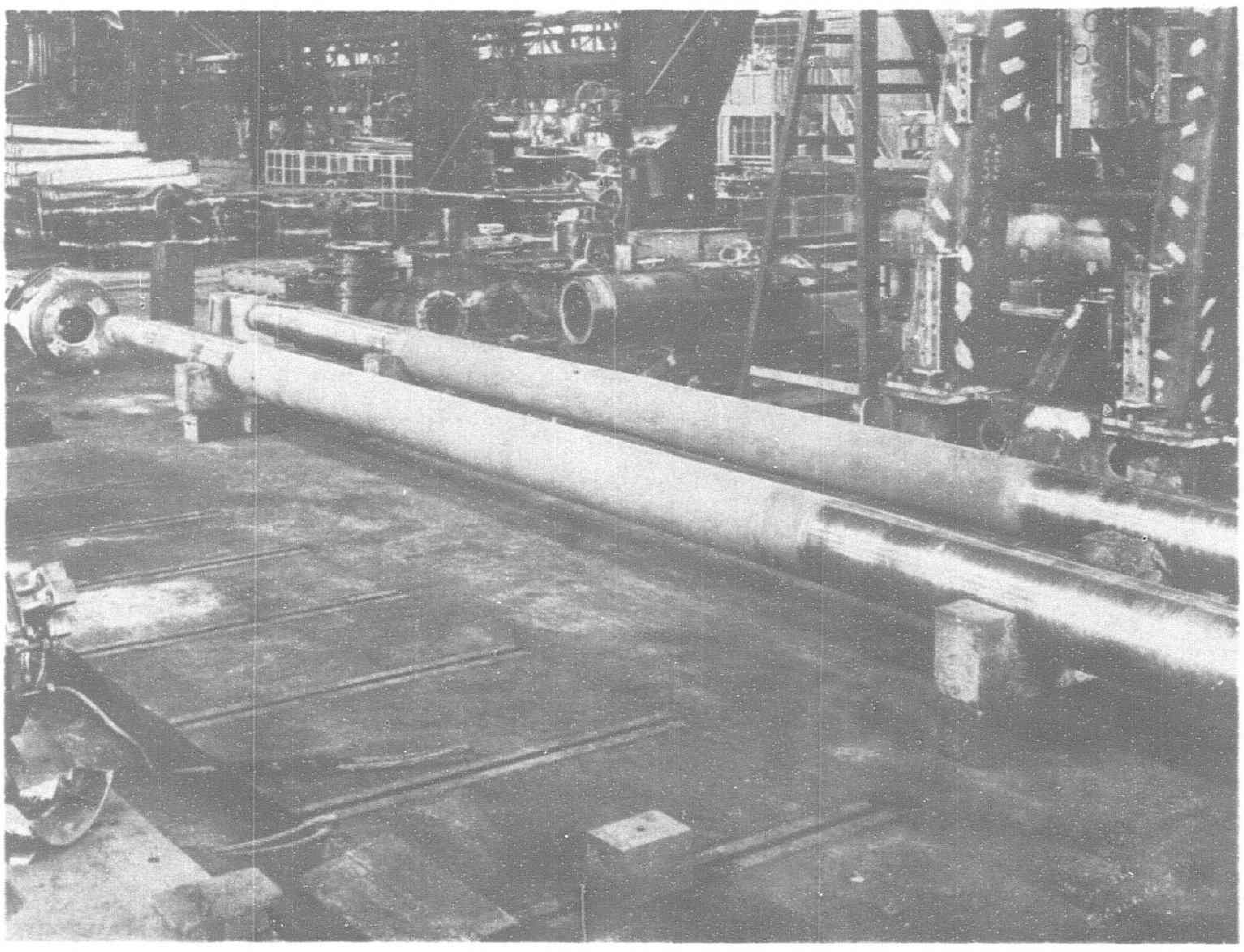
The cloth or rope winding may be just sufficient to protect the shaft from corrosion, provided the work is perfectly done, but such materials often break down and cause difficulty in extracting the shaft out of the stern tube. Besides, re-winding being necessary every alternate year in accordance with the regulations, the labor and material cost would be considerable.

Protective paint for the exposed shaft under continuous running condition also cannot be considered as very satisfactory, as the life of paint under such conditions is comparatively short and it is liable to be scraped off by drifting materials in the sea or friction or any other causes. Therefore, the time allowance for the inspection is shorter in these last two cases, which makes them unfavorable for the economic operation of vessels.

Other Processes

The fescolizing process and electrolysis eliminators are not yet well-tried, and their efficiency is still doubtful, whilst the initial expense is fairly high and also special arrangement is necessary for re-fescolizing or replacement.

The vulcanized rubber covering process has been well developed in Japan and has hitherto been adopted in naval vessels, but recently for the first time in commercial vessels, it has been applied to the large propeller shafts of the ice-breaking passenger ship *Soya Maru* of the Imperial Japanese Government Railways built in the Yokohama Dockyard.



Finished and Half Finished Shafts in Shop

The history of protective rubber covering dates back to the Russo-Japanese War time, when two Russian armored cruisers sunk by Japanese gun fire at the outbreak of the war were raised later and it was found that their propeller shafts were covered with india rubber, perhaps for protection from corrosion. The idea being very interesting, the Imperial Japanese Navy started an investigation independently, and the propeller shafts of the torpedo boat *Kiji* were first experimentally covered with vulcanized rubber under special process in 1909. When these shafts were carefully examined after a lapse of fourteen years, it was found that the surfaces of the shafts after removing the covering had quite as brilliant a luster as originally, whilst the coverings themselves showed only very slight damage and defects. This marvellous result brought about the adoption of this process for submarines and special service vessels of the Imperial Navy.

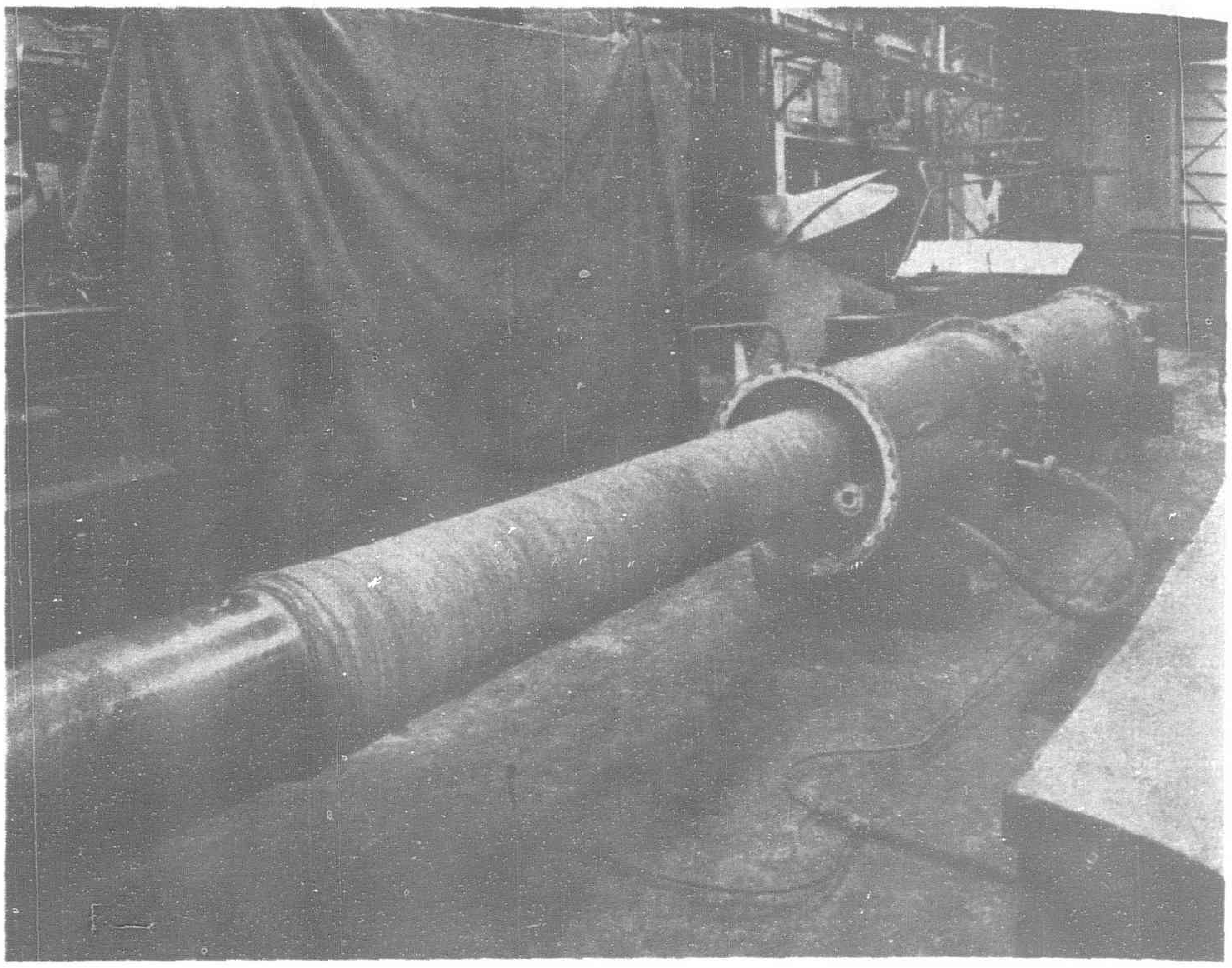
In the latest practice, the original material is special rubber sheets prepared from pale crêpe rubber or smoked rubber sheets added with suitable quantities of sulphur, coloring material, *agelite* or other anti-ageing compounds and other chemicals which furnish the required strength and elasticity and anti-fouling property. The hardness of rubber varies radially in the finished covering, this being mainly controlled by the percentage of sulphur content and the time for the sulphuration. The finished hardness for the shaft covering is generally specified to be 80—90 under a Shore's durometer and a permanent set under a plastmeter 0.1 mm. at .54 mm. of deformation. The finished material used for the shafts of the s.s. *Soya Maru* has a mean maximum tensile strength of 8,064.5 lb. per sq. in. and a mean elongation of 2.8 per cent for the ebonite part near the steel shaft surface, whilst in the outer layer of elastic rubber quality 1,209.0 lb. per sq. in. and 181.5 per cent were recorded, the material having been tested by a Schopper's tension testing machine.

General Requirements

General properties specified for the protective rubber covering of shafts are (*a*) the material and surfaces should be homogeneous and plain without air holes or other defects and should have a superior property to fit tight with the steel surface and not to contain any harmful element which may cause corrosion on the steel surface, (*b*) the material should not only be suitable to protect the shaft from corrosion, but also should maintain perfect tightness with the steel surface notwithstanding the expansion and contraction of the shaft due to an abrupt change of sea water temperature, (*c*) the covering being painted with anti-fouling paint, the material should not be affected by such painting, (*d*) the covering consisting of two layers, the inner layer should be of ebonite quality which firmly connects the outer layer and the metal surface of the shaft, whilst the outer layer should be quite tough for the protection of the surface from damage, (*e*) the ends of the covering should be tightly fitted to the stepped grooves made in the shaft sleeves in order to prevent the penetration of sea water into the contact surface.

The s.s. *Soya Maru*,* the first commercial ship applied with this process, has a gross tonnage of 3,560 tons and her propeller shafts are the largest in diameter ever applied with this process, the shafts having a diameter of 390 mm. (about 15-in.) and a length of 15.8 meters (about 52-ft.) transmitting normally 5,500 horse-power. The vessel plying between Karafto and Hokkaido through thickly frozen seas, in winter time, the hull is suitably constructed to break ice of over ten feet thick.

The rubber material for her shaft covering was supplied by the Meiji Gum Company and the work was carried out by six workmen despatched from this company to the machine shop of the Yokohama Dock Company, where the ship was built and engined.



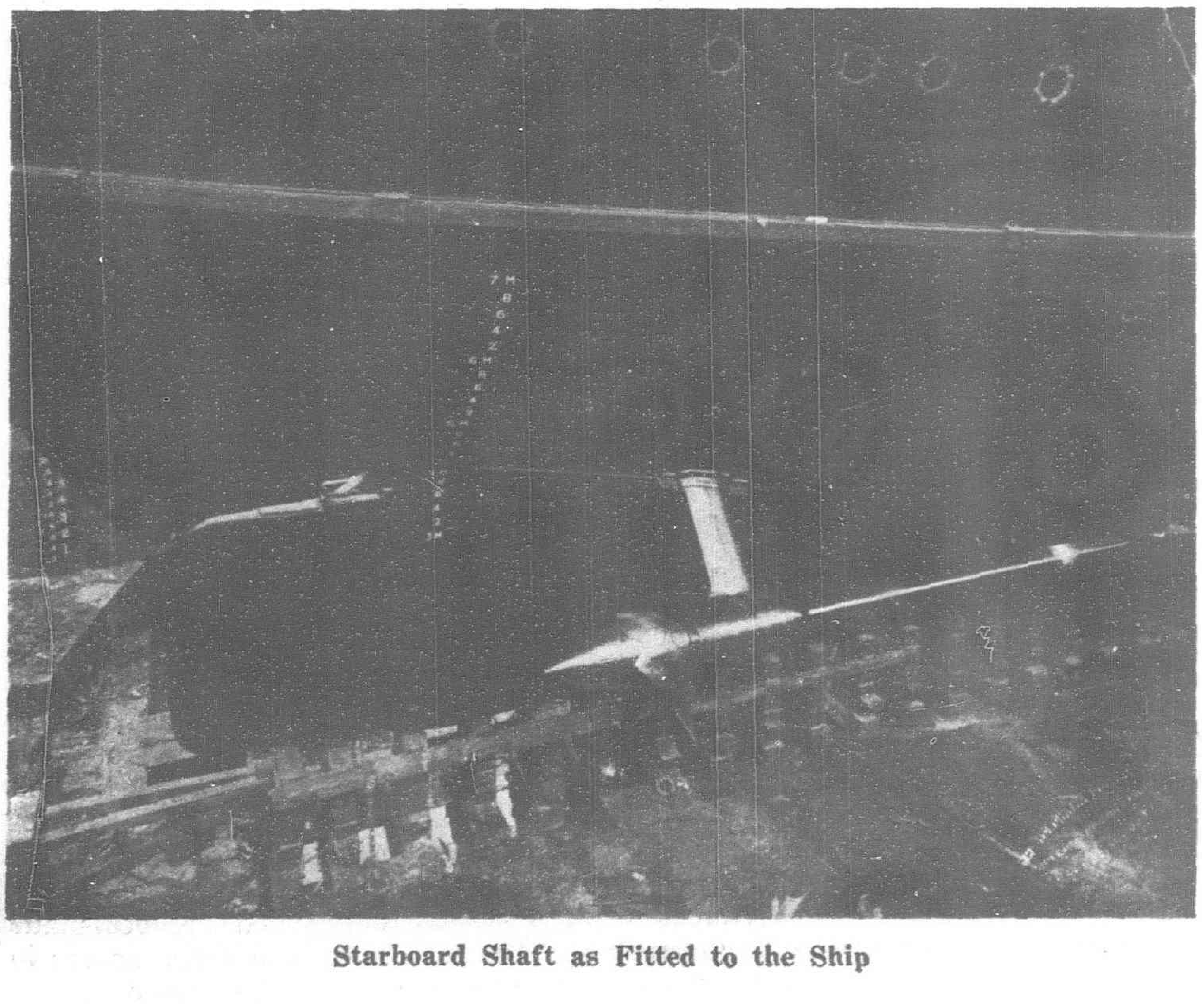
Showing preparation for Heat Treatment in Shop

The shafts were first machined roughly, having left shallow spiral grooves around the surface, and the parts of the brass sleeves in contact with the rubber covering were coated with solder in order to make them tight fitting to the covering at the ends. The parts of the shaft to be covered with rubber were first heated for a few hours in a special cylindrical vessel by steam heat at 258 deg. Fah. and a pressure 20 lb. per sq. in. in order to remove all harmful materials on the surface, such as oil, grease and dirt, and then the shaft was left to cool in the air. After removing rust on the surface of the cooled shaft using emery cloth, it was thoroughly painted with a thick solution of ebonite material in benzine and was left for about one hour until the benzine had completely evaporated. A rubber sheet of ebonite quality of about 1 mm. thick with a width equal to ½ circumference of the shaft and a length as required to be protected, was stretched upon the semi-surface of the shaft and it was firmly pressed to stick on the surface and air bubbles were completely removed by means of hand rollers and by turning the shaft by shop cranes. The remaining semi-surface of the shaft was similarly treated.

The second layer was placed under similar precaution after having wiped the surface of the first layer with benzine, but the seams were arranged at right angles to those of the first layer. The removal of all air bubbles between sheets is very important, as they are very harmful for the sulphuration. In this way, four layers of rubber sheets were placed around the shaft making a total thickness of about 4 mm. Before the sulphurating operation, this rubber-laid shaft was tightly bound by wet cotton tape of about 5-in. width to make double helical layers of the binder and further this was firmly and doubly wound with wet canvas tape of the same width, and moreover it was uniformly and tightly bound by steel wire of gauge No. 12. Such operation was carried out by turning the shaft on a large lathe. This work required two days.

The Heating Process

When the preparation was completed, the shaft was placed in a cylindrical heating vessel, and was exposed to steam heat first for about two hours under a pressure of about 20 lb. per sq. in., and then for about seven hours at about 50—60 lb. per sq. in. of steam pressure in order to attain the complete sulphuration of the rubber sheets. After the completion of this treatment, the shaft was taken from the heating vessel and the binding wires and tapes were removed and both ends of the covering material were carefully adjusted to make a good fitting with brass sleeves of the shaft.



Starboard Shaft as Fitted to the Ship

Four more layers of rubber sheets with somewhat different constitution were placed on such treated rubber covering in the same manner, and the cloth tape and steel wire winding and heat treatment were carried out as explained before, thus a total thickness of 8 mm. of solid rubber covering was obtained.

The result was very satisfactory, and the surface of the covering showed a hardness of about 87 by Shore's durometer, whilst a hard ebonite layer was gradually made toward the inner surface; thus forming the hardest part near the metallic surface and softest part at the outer surface of the covering, where usual toughness of elastic rubber is maintained.

In case of a smaller shaft or a hollow shaft, the bindings and heat treatments are not necessary to be carried out twice. In fact, some of the hollow shafts of naval vessels were treated by single heating operation with the whole layers placed at the same time and tight bindings upon them.

The shaft covering of the *Soya Maru* was carefully examined in dry dock after six months' service under worst sea condition of severe winter with thickly frozen ice, and no significant damage or defect was found in the covering.

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* See *The Far Eastern Review*, April 1933

As to the repair of the damaged rubber covering, the affected part should be at once bound with strong cloth tape in order to prevent further extension of such damage, and should be carefully examined when the vessel is docked. If a part of the metallic surface of the shaft is exposed, the rubber at that part should be removed and the steel surface polished with carborundum cloth, and after wiping the surface with cloth soaked with benzine, specially prepared gum solution is painted. Then, rubber sheets cut in size of the damaged part are firmly stuck on the surface using hand rollers and the patches are piled up to a height somewhat higher than the original rubber covering surface. Parafined cloth or paper is placed upon this together with a set metal. The part is then heated by steam or with an electric heater, upon which a wooden plank and a heavy weight are placed in order to give pressure upon the patch. The material is first heated up to about 150-160 deg. Cent. for about 2-2½ hours in order to unite the repairing material with the original covering. Such repairing materials are conveniently stored on board ship.

In conclusion, the vulcanized rubber covering with its homogeneous tight-fitting may be considered most suitable for the protection of the shaft from corrosion in comparison with other processs hitherto introduced, and it is lighter and cheaper than brasse sleeves.

The actual cost for the rubber covering of the propeller shafts of the s.s. *Soya Maru* and the estimated cost for the brass sleeves for the same shafts are Y.13,168 and Y.16,650 respectively, the corresponding weights per shaft being 14,699 kgs. and 15,759 kgs. respectively. Thus a saving of about 21 per cent in cost and about 6.8 per cent in weight were attained in comparison with brass sleeves.

The writer is greatly indebted to Mr. T. Morisawa, the late Manager of the Marine Department of the Imperial Japanese Government Railways in utilizing the full informations about the shaft covering of the s.s. *Soya Maru*, and also to Mr. F. Tsutiya, the Chief Engineer in the Yokohama Dock Co., Ltd. where the complete operation was carried out.

The Nankow Pass on the Peiping-Suiyuan Railway

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present location, and, according to the records now available, he spent only about two million dollars (Mexican) in completing the Nankow Pass section. With the line gradually extended toward the West, and with the rolling stock depleted of brakes, the necessity of improving the existing conditions becomes more and more apparent.

Many schemes have been proposed to improve the situation. One proposal (A) was to add an intermediate crossing station between every two adjacent stations, to build a through loop, for crossing long empty trains, at each of the stations, TYN, CYK, SPU, CLO and HPT, and to lengthen all the catch sidings in the Pass. A second proposal (B) was to electrify the Nankow Pass section, making use of the water power of the Yungting River, or of the Che Ming Shan coal for the generation of electric power. A third scheme (C) was to abandon the existing main line between Hsichihmen (at Peiping) and Shacheng (a station on main line 21.2 miles west of KCW) and to remodel the existing Mentowkow branch, so that it can be used as a part of the main line, extending it through Tsingpeikou, Chuwokou, Shihchiachwang and Yenchiakou, and rejoining the main line at Shacheng. This new line closely follows the upper course of the Yungting River, and, according to the report submitted by the Locating Engineers, the ruling grade could be made as low as half per cent. For the general plan and profiles, comparing the existing main line with the proposed new line, see Figs. 1, and 5. The cost of constructing this new line was estimated in 1924 to be somewhere about $17,000,000 (Mexican), and, as the cost of materials and the wages of labor are considerably higher nowadays, the estimate when revised will probably be well above $20,000,000.

Of the three proposals, the last one (C) is perhaps the best and most suitable to the traffic requirements; but, as the PSR is in a very stringent condition financially, it is simply impossible now to raise a fund of $20,000,000 for carrying out the work. This will have to wait until a better opportunity comes later on.

The only feasible scheme that can be considered at present, is to replensih air brakes on PSR cars, as well as hand brakes on foreign line cars that now remain on PSR, and to install air brakes on, say, one third of the latter cars, with the other two thirds equipped with air pipes so that compressed air can be connected up throughout any train, thus allowing increase of the loads that can be safely hauled by locomotives now running in the Pass. This is a measure which will only temporarily relieve the present difficulties to some extent. Eventually, the question of relocation must be taken up when the financial condition of the PSR will permit.

Manufacture of Submarine Telegraph and Telephone Cables in Japan

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the application of three layers of coating in one operation. Furthermore, due to the absence of the chatterton compound between the layers, electric characteristics are greatly improved. This is particularly true in case of telephone cables which involve high frequency transmission.

The gutta percha insulated wire which constitutes a core of a submarine cable is subjected to hydraulic pressure of 600 atmospheres, after being left standing for two weeks. It was designed and made by Sumitomo Steel Works with special steel. The tank is reinforced by the bands of forged steel tires, shrank fit to the cylinder. Taping machines, jute serving machines and armoring machines were all designed by the Company, basing processes on their long years of experience and were manufactured by local manufacturers.

The most outstanding difference in the requirements of a submarine cable factory as compared with other cable plant is that the former requires large capacity reservoir tanks for storing extremely long cables under water. Under the present practice, the submarine cables are manufactured, or transported in one continuous length so that it is not unusual to have a cable length as long as several hundreds of nautical miles. As for the means of transportation, there is no other than by cable ship. For this reason, when an appropriate cable ship is not available, it is necessary to store the cable for a considerable length of time. Sumitomo Submarine Cable Works is equipped with several tanks of such large capacity, with ample space for future extension.

The wharf provides about 150 meters of berth by the side of these tanks for cable ships. Attention was given when the *Okinawa Maru* moored at the wharf the first time and it was observed that loading work was performed with extreme ease as anticipated.

Finally, special mention is required to be made of the equipment for the paragutta preparation. As is well known this paragutta is the product of ten years of unfaltering efforts of Dr. Kemp under the supervision of Dr. Jewett of the Bell Telephone Laboratories and an expenditure of one million gold dollars for research. Paragutta may be described as a product obtained by blending refined rubber and deresinated gutta percha or balata mixed with a special wax. It is waterproof and extremely durable. As has been published by Dr. Kemp in technical institute papers its dielectric loss in case of high frequency is extremely small and the general properties as an insulating material are excellent. Had it not been for the development of this material, plan and design of transatlantic submarine telephone cables was technically impractical. It is a well known fact that the recent submarine telephone cable of this type manufactured by Felten Guillaume Co., of Germany, laid between Key-West and Havana is operating with carrier system. Sumitomo Submarine Cable Works is completely equipped with such necessary equipment for paragutta insulated submarine cable manufacture and has already commenced experimentation. Therefore, results will be published ere long

Chiaotung University Where China's Young Engineers are being Trained

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have been planned to impart to students a broad and general knowledge of the principles and methods of science, administration and engineering. Graduates will therefore find it comparatively easy to secure employment in the various educational, government, industrial, and commercial pursuits.

The policy of the University is to recommend all the graduates to the Ministry for employment as student-apprentices in the different departments of the National Railways and Telegraph and Telephone Administrations. Many of the University graduates may be found working in these Government administrations.

Engineering Notes

INDUSTRIAL

EXPERIMENTAL TEA FACTORY.—The erection of an experimental tea factory has been undertaken at Serdang by the F.M.S. Department of Agriculture, and a considerable area of the land at the Cameron Highlands Experimental Plantation has been laid out as nurseries for recently imported tea seed. Developments here will be watched with interest.

KRAFT PAPER FACTORY.—The Japan Rayon Company has decided to build a factory for manufacturing 40,000,000 pounds of kraft paper a year. The factory is at Shikika in Saghalien. Kraft paper is in heavy demand as wrapping paper. The Fuji Paper Company, the only concern producing this kind of paper in Japan, has an annual capacity of 20,000,000 pounds.

MITSUI AMMONIATE FACTORY.—Plans to manufacture ammonium sulphate have been announced by the Mitsui interests. The concern, styled the Toyo Koatsu Kogyo Kabushiki Kaisha, or Oriental High Pressure Industry Co., Ltd., will have a capital of Y.20,000,000. The factory will be built adjacent to the Miike Nitrogen compound, and will use air fixation methods. Annual output is estimated at 120,000 tons.

CANNING FACTORY FOR MALAYA.—The Malayan Government is devoting attention to the pineapple canning industry, and plans are ready for a model estate and canning factory in Selangor. Thanks to an intensive campaign, no less than 911,000 cwt. of canned and bottled pineapples were exported to the United Kingdom during 1932, which is a 33 per cent advance on the previous record figures of 685,000 cwt. in 1931.

COMMUNICATIONS

JEHOL ROAD MAKING.—Construction of roads being a primary consideration in Jehol in view of the existing primitive stage of transport facilities, the State Highways Bureau has started to build highways between Peipiao and Chengteh and between Chaoyang and Chihfeng. On their completion, some time during the latter part of this year, motor traffic will be opened. Other modern means of transportation are also being studied.

CANTON TRAMWAY.—Plans approved by Canton Municipal Government, to be carried out at once, give the city new commercial, agricultural, residential and amusement areas, and call for the construction of tramway lines, aerodromes, railway stations and maloos. Considerable interest attaches to the tramway project as despite its large size Canton is without a tram service. A tramway covering many of the principal thoroughfares was laid over ten years ago, but on account of a dispute between the company and the Government, the service was never inaugurated.

ROAD BUILDING IN CHEKIANG.—The whole of the Hweichow Valley section of Chekiang Province is alive with road makers. Shuenan is to be connected up with Hweichow, and before the end of the year the motorist is promised a round trip from Hangchow via Yuhang, Changhwa, Chihchi, Shihhsien, Shuenan Kienteh and thence via Tonglu and Fuyang back to Hangchow. The craze for the motor car, says a correspondent, is like a hind let loose. The Central Government has decreed that all county towns must be linked by modern roads, and evidently these commands are meant to be obeyed.

RAILWAYS

MANCHOUKUO RAILWAY.—The inhabitants of Paotsing district have petitioned the Manchoukuo authorities to construct a railway from Lishuchen to Paotsing, 130 miles. They point out that the district is very fertile and that the scheme, if carried into effect, will prove profitable.

KIANGSI RAILWAY SCHEME.—A project for the construction of a railway between Yushan and Pinghsiang, in Kiangsi, has been examined and will be brought up at the next meeting of the Chinese Executive Yuan. The projected line, which will stretch across north Kiangsi, will be of commercial and strategic importance.

NEW KWANGSI RAILWAY.—Preparations for the construction of the Samshui-Hohsien Railway, an extension of the Canton-Samshui Railway to Kwangsi, are making substantial progress. A preliminary survey of the line is being undertaken and the Liang-Kwang authorities hope that this work will be completed within two months.

LOCOMOTIVES ORDERED.—An important Chinese engineering order has come to Leeds. The Hunslet Engine Company, Ltd., Jack Lane, have been commissioned to build six locomotives for the Hongchow-Kiangshan Railway.

The order has been placed by the Chinese Government Purchasing Commission under Dr. Wang—in connection with the Boxer Indemnity scheme—and it is for six 480 super-heated double bogey engines.

It follows closely on the completion of a heavy tank engine which the same firm have just delivered for use at the Pukow Ferry.—

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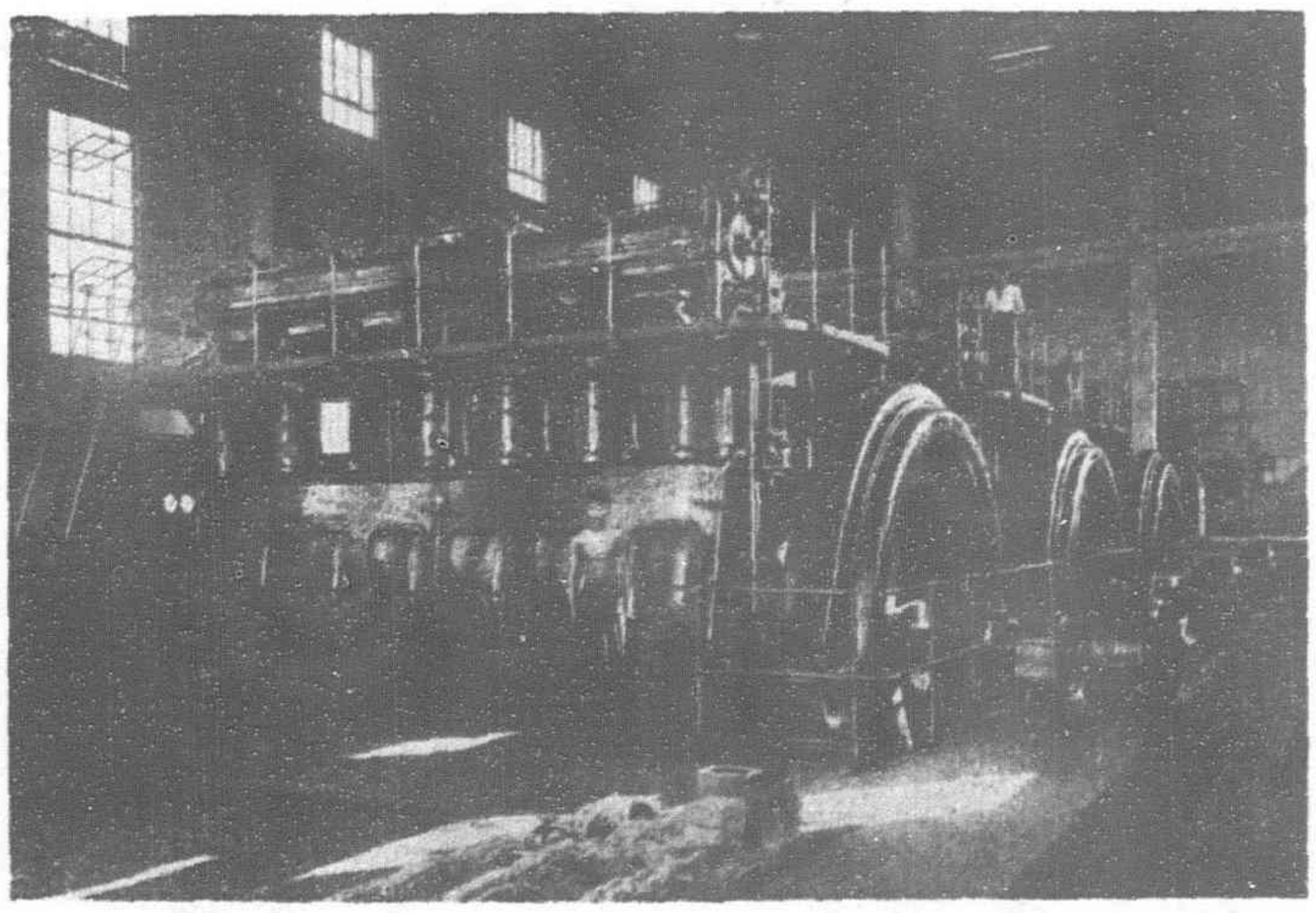

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